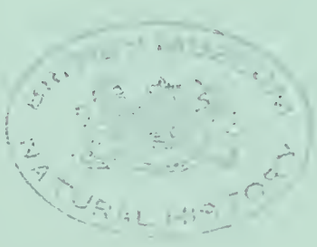
Yorkshire Philosophical Society.

ANNUAL REPORT

FOR

MCMII.



ANNUAL REPORT

OF THE COUNCIL

OF THE

YORKSHIRE

PHILOSOPHICAL SOCIETY

FOR

MCMII.

PRESENTED TO THE ANNUAL MEETING,

FEBRUARY 9TH, 1903.

YORK :

COULTAS & VOLANS, PRINTERS, LITTLE STONEGATE.

1903.

TRUSTEES

OF

THE YORKSHIRE MUSEUM.

APPOINTED BY ROYAL GRANT.

TEMPEST ANDERSON, M.D.

GEORGE A. AUDEN, M.D.

LORD DERAMORE.

CHAS. E. ELMHIRST.

GEORGE S. GIBB, LL.B.

EDWIN GRAY, LL.M.

WILLIAM LAWTON.

T. S. NOBLE.

PATRONS

OF THE

Yorkshire Philosophical Society.

HIS MAJESTY THE KING.

HER MAJESTY THE QUEEN.

H.R.H. THE PRINCE OF WALES.

H.R.H. THE PRINCESS OF WALES.

OFFICERS OF THE SOCIETY, 1903.

PRESIDENT:

Sir Charles Strickland, F.G.S.

VICE-PRESIDENTS:

The Very Rev. the Dean of York.

John Francis Walker, M.A., F.L.S., F.G.S., F.C.S., F.Z.S., late Fellow of Sidney Sussex College, Cambridge.

Tempest Anderson, M.D., B.Sc., &c., Fellow of University College, London.

The Rev. W. C. Hey, M.A.

James Melrose, J.P.

George S. Gibb, LL.B.

Henry Cowling.

T. S. Noble.

Richard Thompson.

The Rev. W. Haworth, F.S.A.

HON. TREASURER:

Edwin Gray, LL.B.

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Elected 1901...G. A. Auden, M.D.
The Rev. E. S. Carter, M.A.
T. R. Kitching.
The Rev. E. C. Owen, M.A.

Elected 1902...L. Foster.
Geo. Benson, A.R.I.B.A.
Hugh Richardson, M.A.
The Rev. J. Solloway, M.A.

Elected 1903...M. B. Cotsworth.
M. Spence.
W. F. H. Thomson.
C. Wakefield.

HON. SECRETARIES:

Tempest Anderson, M.D.

Chas. Elmhirst.

CURATORS:

Archæology - - - - -	T. Boynton, F.S.A. The Rev. W. Haworth, F.S.A.
Geology - - - - - - -	J. F. Walker, M.A., F.G.S.
Mineralogy - - - - - -	W. H. Hudleston, M.A., F.R.S.
Comparative Anatomy - -	T. Anderson, M.D., B.Sc.
Ornithology - - - - -	J. Backhouse, F.Z.S., M.B.O.U.
Botany - - - - - - - -	H. J. Wilkinson.
Observatory - - - - -	T. S. Noble.
Meteorology - - - - -	The Rev. W. Johnson, B.A.
Laboratory - - - - - -	J. F. Walker, M.A., F.I.C., F.C.S., London and Berlin.

GARDEN COMMITTEE:

J. Melrose, J.P.

Sir C. A. Milward.

H. Dennis Taylor.

The Secretaries (*ex-officio*)

LECTURE COMMITTEE:

The Rev. E. S. Carter.

G. S. Gibb, LL.B.

M. Spence.

R. Thompson.

The Secretaries (*ex-officio.*)

KEEPER OF THE MUSEUM:

Henry Maurice Platnauer, A.R.S.M., B.Sc.

REPORT OF THE COUNCIL
OF THE
YORKSHIRE PHILOSOPHICAL SOCIETY.
FEBRUARY 9TH, 1903.

THE Council in presenting its Report for 1902, is able to congratulate the Society on the progress made during that period. In the following summary, external affairs affecting the Society, the internal history and its financial position will be successively dealt with.

In dealing with the subject of passing events in the city, your Council cannot ignore the project now under discussion by our City authorities for "beautifying" the ramparts—that is planting them and laying them out for walks, preparatory to throwing them open as public playgrounds. Against this desecration of our antiquities your Council has already protested. For this they have been fiercely attacked, and some people have not hesitated to assert that members of this Society, from the vantage ground of their own beautiful gardens, are trying to close open spaces to their less favoured fellow-citizens. A Society which has given up paying property, and spent hundreds of pounds on the protection and development of the city's antiquities, can afford to smile at such accusations. Indeed it is difficult to believe that they were made seriously, though they unfortunately mislead the thoughtless and ill-informed. But however our action may be received, or our motives construed, it is our plain duty to resolutely protest against any attempt to mar the dignified simplicity of our ancient monuments, and to impair their historical value, by ill-advised adornment. Besides this, planting may be a positive source of danger, as the case of Clifford's Tower shews only too plainly. There is no member of the Society that would not gladly see open spaces devoted to the recreation of all our citizens, and made pleasant and attractive for this purpose. Our Strays might well be utilized in this manner, but such pleasure grounds could be, and

should be, provided without the adoption of schemes that endangered the antiquities of our city.

It is with peculiar pleasure that your Council records the work done by Dr. Tempest Anderson, a Vice-President and Honorary Secretary of this Society. His appointment by the Royal Society to investigate the results of the recent outbursts in the Windward Islands was a gratifying recognition of many years' study of volcanic phenomena in various parts of the world. It reflects no small credit on this Society that one of its members should have been selected by the hightest scientific authorities in the country to carry out so important a work. The results of his labours, and those of his colleague, Dr. Flett, are embodied in a report to the Royal Society; but Dr. Anderson kindly gave the citizens of York an opportunity of hearing and seeing the most important of these results by delivering a lecture in the Festival Concert Room, illustrated by lantern pictures from photographs that he had taken at the scene of the disasters.

Among the most interesting work done during the year has been that undertaken by the County Committee for the preservation of Clifford's Tower. Those entrusted with this work have shewn themselves very wishful that specimens found, and observations taken, during its course should be preserved and recorded by this Society; and our special thanks are due to Mr. F. J. Munby (the Castellan), Mr. Mott (the Engineer), and Mr. Talbot (the Superintendent of the work), for the facilities they have afforded to Mr. Benson and the keeper of the Museum for investigating the excavations. The results of these investigations will be given in another part of this report.

Turning to the internal affairs of the Society, the first subject that claims our attention is that of the excavations in the choir of S. Mary's Abbey Church. On this it is necessary to dwell at some length, as many people seem to misunderstand the work and the aims of the excavation committee in carrying it out. The remains of the wall foundations disclosed were so saturated with moisture and so denuded of cement that they were rapidly disappearing, and prompt measures had to be taken for their protection. They were also so fragmentary that the ordinary visitor could not have readily gathered from them

what the original plans of the old choirs had been. The Committee has experienced much difficulty in dealing with this matter and has spent much time in considering it. They sought the advice of Mr. St. John Hope (Secretary of the Society of Antiquaries), and Mr. Micklethwaite, the restorers of Fountains and Kirkstall Abbeys respectively, and have acted on their opinion, leaving the execution in the skilled hands of Mr. Brierley. The outline has been restored in brick; this was used in preference to stone that there might be no confusion between the original work and the additions now made, and in order that the eleventh century work could be at once distinguished from that of the thirteenth century, different coloured bricks were used in the two, blue has been used for eleventh century work and red for all that of a subsequent date. The whole will be protected by flag-stone and rock asphalt. The work has been criticized on the ground of its unsightliness, but such criticism is like condemning an architect's plan for hardness of outline and crudeness of colouring. The work of the Committee is nothing more nor less than an architect's plan in brick and stone, and when complete a coloured plan will be framed and placed near for the guidance of visitors. We feel sure that members would not have us sacrifice historical accuracy to picturesque effect, and we should always bear in mind the purpose and history of this Society. We have the custody and use of a valuable piece of ground at a nominal rent. This was accorded us by the Crown, not as a special privilege, but as a trust. The condition of this trust is the preservation of the monuments of antiquity on our premises; we should break the spirit of our convention, and ill-deserve the title "philosophical," if we sacrificed antiquarian considerations to those of mere effect. We may mention too, that the work has met the approval of the Royal Society of Antiquaries and of the Yorkshire Archæological Society, both of which have made money grants towards defraying the expenses.

An inspection of the subjoined list of papers and lectures will shew that the Society maintains its activity, especially when it is added that the average attendance has been larger than ever.

As in previous years, your Council has done all in its power to help forward the work of kindred Societies and to assist in great public functions. The gardens and museum were placed at the disposal of the Lord Mayor (Mr. Ald. L. Foster), for a reception intended to celebrate the coronation of his Majesty King Edward VII ; and the museum and grounds were thrown open to the public on the day on which this event should have taken place.

At the meeting of the Reformatory League held in York in 1902, the members attending the Conference were allowed the use of the museum and grounds. The York Medical Society, the York Universities' Extension Committee, and the York Field Naturalists' Society have made use of our premises as in past years, and during the year the Council has extended this hospitality to the Yorkshire Architectural and York Archæological Society. By an arrangement made with Mr. Jalland's Company, the members again had the privilege of seeing an out-door play performed. Permission has been granted to Elementary and Secondary Schools within a radius of twelve miles from York to visit the museum free of charge, on certain specified conditions, carefully framed to ensure the safety of the collections and the adequate control of the pupils. The plan of having Student Associates has been put into operation and with good results.

An attempt is being made to label the antiquities in the basement of the "hospitium"; if the experiments now tried are successful, the work will be carried out.

Special thanks are due to Mr. James Backhouse for his munificent gift of over two thousand European bird skins. This donation will be referred to more in detail in the report of the Ornithological Department, but it deserves at least passing notice here.

The proceeds of Dr. Anderson's lecture in the Festival Concert Room have been, at his special request, devoted to the Excavation Fund. So well was this lecture attended that, despite somewhat heavy expenses, a sum of about £20 was added to the fund in question. The illustrated lecture on the Cruise of the *Ophir*, given by Lord Wenlock in the Festival Concert Room, was enthusiastically received by a crowded

audience. As the public was admitted on payment, a profit was made on the lecture amounting to upwards of £19. This sum was handed over by the Society to the York County Hospital.

The financial aspect of the Society is encouraging. In spite of the heavy expenses of the excavations and a considerable expenditure necessitated by the condition of S. Leonard's Hospital, the balance is on the right side. This balance, it is true, is barely £2, but it is a matter for congratulation that the Society should have emerged from a year of exceptional expenses with any balance in hand at all. A substantial increase in members' subscriptions and a rigid economy in almost every department of the museum (the necessity for which the Council deeply regrets), are the main causes of this favourable result. But we must not, in our satisfaction at the management of a successful year, lose sight of the heavy debt with which the Society is burdened. A sum of £1,900 has to be repaid to the Yorkshire Insurance Company, and the Society's financial position cannot be considered in a permanently satisfactory condition so long as this heavy burden remains. The Council still urges benefactors of the Society to seriously consider the scheme for dealing with this debt which was proposed four years ago.

ARCHÆOLOGY.—No valuable specimens have been added to our collection during the past year. Many objects have been obtained from the excavations at Clifford's Tower, and from those made during the extension of the York Union Bank and the re-building of Thompson's house in High Ousegate, but these possess no special value beyond illustrating the age of the soil in which they were found.

The most important matters affecting this department, viz., the preservation of Clifford's Tower, the excavations in the Choir of our Abbey, and the protection of the City Ramparts will be found dealt with in the General Report of the Council.

The collections are in good order, and your Hon. Curators note with satisfaction the increasing extent to which they are

visited and utilized by antiquaries. Photographs and drawings of objects in the Museum have been sent to two firms of publishers for illustration of popular works on Archæological subjects.

It is a matter for regret that more students do not apply themselves seriously and systematically to the study of Archæology. Working Naturalists are to be found all over the country, but comparatively few, even in so promising a field for investigation as York, devote themselves to the study of antiquity.

In this connection the Hon. Curators would like to point out the great service which could be rendered to this study by architects. The valuable services of Mr. Brierley, in the conservation and development of our ruins, and the highly interesting donation of Mr. Taylor (see Annual Report, 1901, p. 104), will at once occur to our members. But we refer especially to cases in which they are in charge of works necessitating a large amount of excavation. The papers of Mr. Benson in this, and in previous reports, are useful examples of what might be done in this direction. Careful records of old buildings demolished, and notes of anything met with in course of digging—such as the nature and thickness of the soils gone through, the kind of objects found, &c., should be sent for incorporation into our Annual Reports. Engineers and builders, it is also suggested, might greatly render assistance in the same way.

Botany.—No additions have been made to the collections during the past year. The work done in the department will be found recorded on pp. 33—42.

Comparative Anatomy.—The Hon. Curator reports that the collections are in good order, and that no material change has been made during the year.

Geology. — The Hon. Curator reports that the only specimen added to the collection during the year is a piece of the Ludlow Bone Bed, presented by Dr. Auden. Specimens have been lent for examination and description to Mr. Kidston and to Mr. Wheelton Hind. Mr. H. Woods has figured the

following Chalk Bivalves in the publications of the Palæontographical Society—*Pecten elongatus*, *Pecten asper*, and *Pecten beaveri*.

Library.—The additions made to the Library during the past year have been numerous and useful. We hail with special delight the gift of "The Summary of Progress of the Geological Survey of 1901," presented to us by the Board of Education. Hitherto, the permanent officials of Governmental departments have been at no pains to make the results of our surveyors' and explorers' work accessible to the public. The Museums' Association (founded in York in 1889) has made repeated protests on this subject, and remonstrances from isolated Societies and from private individuals have not been lacking. At last an effort has been made to let the public benefit by the labours of public officials, and we have good hopes that the donation of the useful little volume referred to may indicate the beginning of a new era.

Meteorology.—*Statistics of Station:* Longitude 1° 5′ W.; Latitude 53° 57′ N.; height above mean sea level, 56 feet.

Temperature in 1902 had a range smaller by 4° than that of the previous year, the mean annual temperature being lower by 1·4° F., 47·3, as against 48·7. The lowest temperature was recorded on February 12th and 13th, when the absolute minimum thermometer read 18°·0 F., whilst the highest reading occurred on June 28th, when a reading of 83° F. was taken. In order to account for the late season it may be pointed out that April and May were both colder than the average of these months. The mean temperature month by month, until October, is 4° and 5° lower, a fall which coincides with the general fall of surface temperatures observed in the Atlantic Ocean. Ample compensation, however, was made in the later months by a succession of S., S.W. and W. winds, and the mean of October, November, and December, shows an equivalent rise.

A Mean Pressure of 29·947 inches has been recorded as against 29·935 for 1901, March and November being lowest with 29·770 inches and 29·886 inches respectively; January and September being highest with 30·075 inches, and 30·060

inches respectfully. The extreme range of pressure being 2·269 inches, as against 1·954 inches; in 1891 the highest reading being taken on January 31st, 30·945 inches at 9 p.m., and the lowest 28·676 on December 29th at 9 p.m.

Rain or Snow (0·005 inches or over) fell on 192 days, 5 fewer than in 1901, the total rainfall for the year being only 18·69 inches, a falling-off of 1·83 inches as compared with 1901, which was itself 5·42 inches below the previous year. It deserves attention, in face of the oft-repeated statement that York is a very wet place. Observations show that York is among the places of lowest rainfall in the Kingdom. The heaviest fall occurred on April 15th, when ·86 inches fell, little more than half of the heaviest fall of the previous year. In no single month was the rainfall 2·5 in. Popular impressions are thus disproved by exact observation. The wettest of our months was July with 2·31 inches, and as May and June were close behind it, it may be that the impressions of cricketers have stamped the whole year.

The cumulative totals since 1841 are now:—August 166·28 inches, October 164·95 inches, July 157·00 inches. The *Observation of Winds* show that only on three days has there been a "gale," whilst the chief air-currents have been W. (172), S. (134), N. (122), E. (76), S.W. (70). Days of clear sky reach only 31 as against 59, whilst overcast reaches 142 days as against 106, the mean amount of cloud being 6·6 as compared with 5·8.

The Sunshine Returns for 1900 were incomplete, but comparing the 8 completed months (May — December) there is a falling-off for 1902 of 224·5 hours of sunshine, a loss of energy which nothing artificial can re-place.

Mineralogy.—The collections of Minerals, &c., are in good order, but there has been no material increase in the number of specimens during the year 1902. We have to thank Mr. Abbott for an interesting series of concretions from the Magnesian Limestone of county Durham.

Ornithology.—The collections in the department have been enriched by an addition of unusual importance. The Hon. Curator, Mr. James Backhouse, has presented to the

Society his collection of skins of Western Palæarctic Birds. In this collection there are several items of peculiar interest to the Ornithologist; thus, for instance, the Iceland Rock Ptarmigans form a set which is probably unique. But the main point of importance to us is that the Society acquires, through Mr. Backhouse's generosity, a representative series of over 2000 birds' skins, illustrating a Zoological Sub-region, of which these islands form a part. The collection is contained in six well-made cabinets.

Photographic Section.—This section continues to display vigorous activity. The average attendance at the Monthly Meetings has been 11, or more than one-third of the total number of members, and visitors have been present as guests at nearly all the meetings. The plan of having occasional competitions, each confined to some special line of work, has been continued, and has greatly stimulated interest. Competitions have been held in Landscape, Portraiture, Architecture, and Interior Views, with excellent results. Any Members, Associates, or Lady Subscribers of this Society, may join the Photographic Section by paying a subscription of 2/6 per annum to either of the Hon. Secretaries—

H. Dennis Taylor,
Stancliffe, Mount Villas,

Malcolm Spence,
Almery Garth, Marygate.

Others who are interested in Photography, but are not connected with this Society, may join the Section and attend the Meetings on payment of an Annual Subscription of 5/- per annum.

THE TREASURER'S ACCOUNT IN CONNECTION WITH THE FUND FOUNDED BY THE LATE WM. REED, ESQ., FOR SPECIFIC PURPOSES.

Dr. INCOME. **Cr.**

	£	s.	d.
Interest on £600 York Corporation 3 % Redeemable Stock, less Income Tax	16	18	3
Interest on £50 placed on Deposit at York City and County Bank	1	5	5
	£18	5	6

EXPENDITURE.

	£	s.	d.
Books and Binding	18	3	8
	£18	3	8

BALANCE SHEET.

	£	s.	d.
Amount of Fund on 31st December, 1902	687	19	2
	£687	19	2

	£	s.	d.
Amount invested in York Corporation 3 per cent. Redeemable Stock	600	0	0
Amount placed on Deposit at York City and County Bank	50	0	0
Cash in Hand	37	19	2
	£687	19	2

E. GRAY, *Hon. Treasurer.*

Examined and found correct,
PHILIP L. NEWMAN.

METEOROLOGICAL STATION, YORK.—THE MUSEUM.

Longitude 1° 5′ W., Latitude 53° 57′ N. Height above Mean Sea Level 56 ft. Gravity Correction + ·024 in.

1902.	Mean Pressure at 32° Fahrenheit and M. S. Level	Air Temperature.									Humidity.								
		9 a.m.	9 pm.	Mean.	Means of		Absolute Min. and Max.				Deprn. of Wet Bulb.			Tension of Vapour.			Percentage.		
					Min.	Max.	Min.	Day.	Max.	Day.	9. am.	9 p.m.	Mean.	9 a.m.	9 p.m.	Mean.	9 a.m.	9 p.m.	Mean.
	ins.	°	°	°	°	°	°		°		°	°	°	in.	in.	in.	%	%	%
Jan.	30·075	39·6	40·0	39·8	36·3	45·4	25·0	27th	53·0	9th	1·4	1·5	1·5	·215	·217	·216	89	88	89
Feb.	29·886	33·6	34·7	34·2	30·0	39·9	**18·0**	**12.13**	55·0	28th	0·7	0·7	0·7	·179	·188	·184	92	93	93
Mar.	·770	42·5	42·3	42·4	37·3	51·0	29·0	6th	58·0	18th	1·9	1·9	1·9	·232	·230	·231	85	86	86
April	·954	47·2	43·9	45 6	37·7	54·3	29·0	10th	65·0	19th	3·5	2·5	3·0	·245	·233	·239	76	81	79
May	·948	48·5	46·1	47·3	41·0	54·9	32·0	9th	75·0	23rd	4·4	2·8	3·6	·241	·249	·245	71	80	76
June	·931	56·7	54·5	55·6	48·3	65·0	35·0	10th	**83·0**	**28th**	3·2	2·5	2·9	·368	·354	·361	80	83	82
July	·990	59·0	56·3	57·7	50·2	66·3	40·0	25th	78·0	15th	4·3	2·8	3·6	·372	·374	·373	75	82	79
Aug.	29·911	57·4	54·6	56·0	49·2	64·6	41·0	11th	71·0	15-6,26	3·1	1·9	2·5	·381	·373	·377	81	88	85
Sept.	30·060	55·7	53·8	54·8	48·6	63·3	38·0	13th	74·0	8th	3·2	1·8	2·5	·356	·363	·360	89	87	84
Oct.	29·964	49 6	47·8	48·7	43·6	54·9	33·0	12th	60·0	23, 24	1·5	1·1	1·3	·317	·306	·312	90	92	91
Nov.	·886	43·3	44·7	44·0	40·0	49·0	28·0	22nd	59·0	1st	1·1	1·5	1·3	·256	·262	·259	92	89	91
Dec.	29·985	41·0	41·5	41·3	37·5	45·8	26·0	7th	56·0	16, 17	1·7	1·8	1·8	·221	·225	·223	86	87	87
Year	29·947	47·8	46·7	47·3	41·6	54·5	——	——	——	——	2·5	1·9	2·2	·281	·282	·282	83·1	86·3	84·7

STATION, YORK.—THE MUSEUM.

Heights above Ground :—Barometer, 3 feet ; Thermometers, 4 feet ; Rain-gauge, 1 foot.

1902.	Amount of Cloud.			Rainfall.			Weather, No. of Days of							Wind, No. of Observations of								
	9 a.m.	9 p.m.	Mean	Total.	Max.	Day.	Rain.	Snow.	Hail.	Thunder Storm	Clear Sky.	Over-cast.	Gale.	N.	N.E.	E.	S.E.	S.	S.W	W.	N W	Calm.
				ins.	ins.																	
Jan.	6·6	5·9	6·3	1·01	·28	10th	13	1	0	0	4	12	0	14	2	1	0	5	6	27	7	0
Feb.	7·2	6·8	7·0	1·26	·28	26th	12	3	0	0	3	14	0	8	4	8	9	11	4	3	7	2
Mar.	7·4	6·6	7·0	0·97	·23	14th24th	14	2	0	0	0	12	0	3	0	1	1	17	16	21	3	0
April	5·1	3·5	4·3	1·42	·86	15th	11	1	1	2	7	3	0	8	6	12	5	13	4	9	3	0
May	7·2	5·9	6·6	2·23	·47	31st	18	1	0	0	0	9	0	28	2	2	0	5	3	17	5	0
June	7·0	6·5	6·8	1·84	·45	12th	16	0	0	2	3	11	0	14	6	12	5	5	3	10	5	0
July	7·4	7·2	7·3	2·31	·50	25th	16	0	0	2	0	15	0	9	1	3	2	7	6	24	10	0
Aug.	7·5	6·7	7·1	1·93	·69	17th	16	0	0	0	2	16	0	6	4	10	5	15	4	15	3	0
Sept.	5·3	5·3	5·3	0·43	·11	12th	13	0	0	0	6	9	2	11	7	2	4	11	4	12	9	0
Oct.	7·4	7·0	7·2	2·06	·52	13th	22	0	1	0	2	14	0	16	6	5	0	13	10	8	4	0
Nov.	6·4	6·9	6·7	1·33	·35	24th	13	0	0	0	3	13	0	1	0	11	15	22	5	4	1	1
Dec.	6·6	8·1	7·4	1·90	·66	1st	16	4	0	0	1	14	1	4	5	9	3	10	5	22	4	0
Year	6·8	6·4	6·6	18·69	——	——	180	12	2	6	31	142	3	122	43	76	49	134	70	172	61	3

RIVER HEIGHT RECORDS REGISTERED BY THE AUTOMATIC RECORDER AT THE GUILDHALL, YORK, 1902.

Date.	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.		
	Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.		Time.	Above or below S.L.	
		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.		ft.	in.
1	noon	10	9	6 a.m.	0	7	11 p.m.	1	10	6 a.m.	0	3	noon	0	3	12 p.m.	0	10
2	1 a.m.	10	6	noon	0	7	noon	0	11	noon	0	9	,,	0	2	2 p.m.	1	4
3	4 a.m.	10	2	,,	0	6	1 a.m.	0	11	1 a.m.	0	8	,,	0	1	1 a.m.	1	0
4	1 a.m.	8	3	,,	0	6	7 a.m.	0	10	noon	0	4	,,	0	1	6 a.m.	1	0
5	,,	6	1	,,	0	5	6 p.m.	1	0	12 p.m.	0	8	6 p.m.	0	3	10 p.m.	0	3
6	,,	3	10	,,	0	5	noon	0	11	noon	0	9	noon	0	3	noon	0	4
7	,,	1	8	,,	0	5	,,	0	10	,,	0	8	,,	0	3	,,	0	3
8	6 p.m.	1	0	,,	0	4	1 a.m.	0	9	,,	0	7	,,	0	2	,,	0	4
9	8 p.m.	1	1	,,	0	4	noon	0	6	,,	0	5	,,	0	2	6 p.m.	0	6
10	noon	1	4	,,	0	3	,,	0	6	,,	0	3	,,	0	2	noon	0	6
11	7 p.m.	2	8	3 p.m.	S.L.		,,	0	6	,,	0	3	,,	0	1	,,	0	4
12	1 a.m.	2	3	noon	S.L.		,,	0	6	,,	0	3	,,	S.L.		,,	0	3
13	,,	0	9	,,	0	1	,,	0	5	,,	0	3	,,	0	1	,,	0	4
14	,,	1	3	,,	0	3	,,	0	5	,,	0	3	,,	0	1	6 p.m.	0	9
15	2 a.m.	0	8	,,	0	3	6 p.m.	0	7	6 p.m.	0	9	,,	S.L.		noon	0	9
16	noon	0	10	,,	0	3	noon	0	7	12 p.m.	1	5	,,	S.L.		1 a.m.	0	8
17	6 p.m.	0	10	1 a.m.	0	3	,,	0	5	11 a.m.	1	8	,,	0	1	noon	0	7
18	noon	0	9	noon	S.L.		,,	0	5	1 a.m.	1	0	6 p.m.	0	8	,,	0	8
19	,,	0	8	,,	0	2	,,	0	4	,,	0	6	5 a.m.	0	9	7 a.m.	0	8
20	,,	0	8	,,	0	1	,,	0	8	noon	0	3	noon	0	3	noon	0	4
21	10 p.m.	1	5	6 p.m.	0	3	6 p.m.	1	8	,,	0	3	,,	0	3	,,	0	4
22	5 p.m.	1	6	4 p.m.	0	5	,,	1	4	12 p.m.	0	6	,,	0	3	,,	0	3
23	noon	0	11	noon	1	0	3 a.m.	1	4	6 p.m.	2	8	,,	0	3	,,	0	3
24	,,	1	0	5 p.m.	3	9	1 a.m.	1	1	1 a.m.	2	3	,,	0	6	,,	0	3
25	5 p.m.	1	6	2 p.m.	5	0	noon	0	11	6 p.m.	0	9	,,	0	6	,,	0	3
26	3 a.m.	1	4	1 a.m.	4	6	,,	0	11	6 a.m.	0	9	1 a.m.	0	5	,,	0	2
27	6 p.m.	0	6	,,	1	9	,,	0	10	1 a.m.	0	6	noon	0	1	,,	0	1
28	,,	0	9	7 a.m.	1	8	4 p.m.	2	4	noon	0	3	,,	0	1	,,	0	1
29	,,	0	11				,,	1	9	,,	0	4	12 p.m.	0	5	,,	S.L.	
30	,,	0	6				1 a.m.	1	3	,,	0	3	8 a.m.	0	5	,,	S.L.	
31	1 a.m.	0	6				noon	0	6				noon	0	3			

RIVER HEIGHT RECORDS.—*Continued.*

Date.	JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Time.	Above or below S.L.	Time.	Above or below S.L.	Time.	Above or below S.L.	Time.	Above or below S.L.	Time.	Above or below S.L.	Time.	Above or below S.L.
		ft. in.		ft. in.		ft. in.		ft. in.		ft. in.		ft. in.
1	noon	S.L.	noon	0 3	6 p.m.	S.L.	noon	S.L.	1 a.m.	0 6	11 p.m.	1 5
2	,,	S.L.	,,	0 2	noon	S.L.	,,	below 0 3	noon	0 3	9 p.m.	6 7
3	,,	0 2	,,	S.L.	,,	S.L.	,,	0 2	,,	S.L.	1 a.m.	6 7
4	,,	0 2	,,	S.L.	,,	S.L.	,,	0 2	,,	below 0 3	,,	3 4
5	,,	0 2	,,	S.L.	,,	S.L.	12 p.m.	above 1 1	,,	0 2	,,	1 6
6	,,	0 2	,,	S.L.	,,	0 1	10 a.m.	1 2	,,	0 1	,,	0 10
7	,,	S.L.	,,	S.L.	,,	0 2	1 a.m.	0 9	5 p.m.	0 4	,,	0 9
8	,,	below 0 1	,,	S.L.	,,	0 1	12 p.m.	0 7	1 a.m.	S.L.	12 p.m.	0 6
9	,,	0 1	,,	S.L.	,,	S.L.	11 a.m.	0 8	12 p.m.	above 2 4	noon	0 6
10	,,	0 2	,,	S.L.	12 p.m.	S.L.	12 p.m.	1 3	8 a.m.	3 3	,,	0 4
11	12 p.m.	above 0 8	,,	below 0 3	,,	0 7	9 a.m.	3 3	1 a.m.	1 9	,,	0 5
12	noon	0 8	,,	0 2	,,	below 0 7	1 a.m.	2 9	12 p.m.	1 0	,,	0 7
13	1 a.m.	0 9	,,	0 2	,,	1 3	12 p.m.	0 11	6 a.m.	1 2	,,	0 6
14	,,	0 5	,,	0 1	,,	0 9	noon	1 4	1 a.m.	0 7	12 p.m.	1 4
15	noon	0 2	,,	S.L.	6 p.m.	0 6	7 p.m.	1 4	noon	S.L.	,,	4 5
16	,,	S.L.	,,	S.L.	noon	0 6	11 p.m.	4 11	,,	S.L.	,,	6 0
17	,,	S.L.	,,	S.L.	9 p.m.	above 1 0	12 p.m.	2 4	12 p.m.	0 3	,,	8 3
18	,,	S.L.	,,	S.L.	1 a.m.	0 10	6 p.m.	0 8	noon	0 2	1 a.m.	8 3
19	,,	below 0 2	12 p.m.	above 0 8	,,	0 5	noon	0 8	,,	0 1	,,	4 4
20	,,	0 2	9 p.m.	2 2	noon	0 1	12 p.m.	0 3	,,	0 1	,,	1 4
21	,,	0 3	1 a.m.	1 10	,,	S.L.	noon	0 3	,,	S.L.	,,	1 0
22	,,	0 3	6 a.m.	0 8	1 a.m.	S.L.	,,	0 3	,,	0 1	12 p.m.	0 8
23	,,	0 3	noon	0 6	noon	below 0 3	4 p.m.	1 2	,,	S.L.	7 p.m.	0 6
24	,,	0 3	12 p.m.	1 0	,,	0 2	1 a.m.	0 11	1 p.m.	0 4	noon	0 6
25	,,	0 2	,,	0 3	,,	S.L.	,,	0 6	12 p.m.	1 0	,,	0 6
26	6 p.m.	S.L.	6 a.m.	0 6	,,	above 0 2	12 p.m.	0 9	3 p.m.	1 1	2 p.m.	2 0
27	7 p.m.	above 2 10	1 a.m.	0 1	,,	0 2	4 p.m.	1 9	12 p.m.	0 6	1 a.m.	1 8
28	1 a.m.	2 7	12 p.m.	0 1	,,	0 2	1 a.m.	1 6	noon	0 6	12 p.m.	3 0
29	,,	0 3	noon	0 2	1 a.m.	0 2	noon	0 6	9 p.m.	2 8	4 a.m.	3 1
30	noon	0 5	,,	0 2	noon	below 0 3	,,	0 3	1 a.m.	2 8	12 p.m.	1 9
31	,,	0 4	,,	0 2			6 p.m.	0 6			6 a.m.	1 10

OUSE FLOODS FROM RETURNS TO THE CITY SURVEYOR.

COMPARATIVE TABLE, 1902.

Date.	Nidd at Pateley Bridge.		Ure at Middleham Bridge.		Swale at Richmond.	
	Hour.	Height	Hour.	Height	Hour.	Height
		ft. in.		ft. in.		ft. in.
Jan. 2			7 a.m.	6 0		
,, 4			11 a.m.	4 0		
Feb. 24			4 p.m.	3 0		
,, 25			7 a.m.	3 0		
Mar. 28			,,	3 0		
April 22			4 p.m.	5 0	6 p.m.	2 6
July 10			6 a.m.	2 0		
,, 27			5 a.m.	5 0	10 p.m.	4 9
Aug. 19			9 a.m.	2 0	5 p.m.	4 0
,, 23			2 p.m.	3 0		
Oct. 10			3 p.m.	3 0	4 p.m.	3 0
,, 15			,,	6 10		
,, 16			6 a.m.	9 0		
Nov. 9			4 p.m.	6 0	3 p.m.	2 0
Dec. 2			7 a.m.	4 0		
,, 15			,,	8 0	8 a.m.	2 6
,, 16	4-30 p.m.	4 0	4 p.m.	10 0	1-15 p.m.	4 6
,, 17			7 a.m.	7 0	7-30 a.m.	4 0

YORK—THE MUSEUM.

1902.	Highest Barometer.		Lowest Barometer.	
January	30·945	31st, 9 p.m.	29·050	2nd, 9 a.m.
February	·882	1st, 9 a.m.	·247	27th, 9 a.m.
March	·191	16th, 9 p.m.	·013	24th, 9 p.m.
April	·355	7th, 9 a.m.	·483	1st, 9 a.m.
May	·421	25th, 9 a.m.	·162	17th, 9 p.m.
June	·294	25th, 9 a.m.	·464	7th, 9 a.m.
July	·280	2nd, 9 p.m.	·236	26th, 9 p.m.
August	·221	1st, 9 a.m.	·536	18th, 9 p.m.
September	·497	28th, 9 p.m.	·344	3rd, 9 a.m.
October	·423	25th, 9 a.m.	·175	15th, 9 p.m.
November	·479	18th, 9 a.m.	29·217	28th, 9 a.m.
December	30·631	4th, 9 p.m.	28·676	29th, 9 p.m.
Year	30·945	Jan. 31st, 9 p.m.	28·676	Dec. 29th, 9 p.m.

YORK (BOOTHAM)—SUNSHINE VALUES.

Month.	Total Hours.	Percentages.	
	1902.	1902.	1901.
January	31·1	13	...
February	60·0	22	...
March	79·8	22	...
April	175·4	42	...
May	? 146·5	?30	42
June	178·2	35	39
July	160·7	32	46
August	136·6	30	43
September	131·6	35	27
October	59·2	18	24
November	42·3	17	?22
December	16·4	7	17
Year	1217·8	28	...

THE TREASURER IN ACCOUNT WITH THE YORKSHIRE

Previous Year.	Dr. INCOME.	£ s. d.	£ s. d.
	Subscriptions:		
	Town Members	660 0 0	
	County Members	11 0 0	
	Temporary Members...	1 0 0	
	Lady Subscribers	75 0 0	
	Associates	14 0 0	
	Arrears received	26 5 0	
	Keys of Gates	65 1 0	
816			852 6 0
	Donations towards cost of Excavations, etc., at St. Mary's Abbey:		
	The Society of Antiquaries	5 5 0	
	A. St. Clair Carnegy, Esq.	1 0 0	
	Sundry Members—Freemen's Stray Money	4 4 0	
			10 9 0
	Rents:		
	Major Allenby, St. Mary's Lodge	65 0 0	
	Mr. Hill, Marygate Baths	40 0 0	
	York Amateur Rowing Club	5 0 0	
	York and District Field Naturalists' Society, less £2 paid to Attendant	1 0 0	
	York Waterworks Co., for Shed	5 0 0	
	Do. for Light	0 1 0	
	Corporation of York	2 0 0	
	Yorkshire School for the Blind	0 1 0	
	National Telephone Co.	1 0 0	
			119 2 0
	Hire of Tent and Tables	22 13 6	
	Less: Expenses of carriage, fixing, repairs and like ...	9 17 5	
21			12 16 1
	Whitsuntide Admission Fees	12 5 6	
8	*Less:* Attendants and Police	4 2 0	
			8 3 6
	Meteorological Department:		
	Grant from Corporation of York		10 0 0
6	Sale of Catalogues		6 9 0
2	Sale of Photographs		2 14 6
8	Bank Interest		6 18 0
226	Gate Money		212 10 9
28	Interest on £918 8s. 9d. India 3 °/₀ Stock, less Income Tax		25 17 10
	Error in Tradesman's Account for year 1902		0 4 1
	Contribution from the Rt. Hon. the Lord Mayor (Mr. Ald. Foster) for cost of extra labour in preparing ground for Garden Party		1 10 0
	Proceeds of Lecture by Tempest Anderson, Esq., M.D.,	34 8 0	
	less Expenses)	14 15 6	
			19 12 6
1248			1288 13 3

		£1288 13 3
816	Balance in hands of the Treasurer, 31st December, 1902	318 8 0
		£318 8 0

PHILOSOPHICAL SOCIETY FOR YEAR ENDING 31ST DEC., 1902.

Previous Year.	EXPENDITURE.	£ s. d.	£ s. d.	Cr. £ s. d.
	Crown Rent			1 0 0
19	Corporation Rent			18 19 7
	Rates and Taxes:			
39	Property Tax and City Rates		42 0 11	
	Waterworks Company's Rates...		5 0 8	
	Gardeners' Licences		2 5 0	
	Receipt and Cheque Books Stamping... ...		1 17 7	
				51 4 2
	Insurance			7 5 0
	Salaries and Wages:			
	Mr. Platnauer		150 0 0	
	Mr. Fielden		60 0 0	
	Miss Baines		41 12 0	
	Mr. Guy		30 0 0	
	Attendants at Museum and Hospitium, viz:			
	Attendant at Museum	72 16 0		
	Female Attendant at Museum...	26 0 0		
	Female Attendant at Hospitium	32 10 0		
			131 6 0	
	Gardeners, including temporary labour and			
117	extra duty at gates		123 18 2	
				536 16 3
	*Yorkshire Insurance Company, Annuity ...			196 11 8
	General Repairs and Expenses:			
	Museum and Hospitium;			
50	General Additions, Repairs, and Expenses ...		12 15 4	
14	*Estate:* General Repairs		16 19 7	
	Gardens:			
17	General Additions, Repairs, and Expenses ...	12 10 3		
	New Lawn Mower & Repairs to Old One ...	7 16 7		
			20 6 10	
82				50 1 9
11	Music and other Outdoor Entertainments ...			7 4 6
28	Library, Books and Binding			23 12 0
50	Lectures			39 10 2
5	Printing and Stationery			6 0 2
	Printing Communications to Members and			
11	Postage of same			11 4 0
24	Printing Reports and Postage thereof			44 1 10
12	Teas at Monthly Meetings			3 4 4
	Gas, Coal, and Coke:			
28	Museums		27 10 9	
18	Gardens		14 1 7	
21	Estate		21 2 6	
				62 14 10
38	Ornithological Department			10 0 0
	Antiquarian Department:			
33	Purchases		18 1 3	
75	Excavations, etc., at St. Mary's Abbey ...		143 4 8	
	Repairs to St. Leonard's Hospital		27 7 7	
109				188 13 6
21	Meteorological Department			18 7 5
1	Preparation of Photographs for Sale			0 13 4
8	Sundry Postages			7 18 3
2	Sundries, including Carriage of Parcels ...			1 11 2
				1286 13 10
	Excess of Income over Expenditure			1 19 5
1297				£1288 13 3
	Balance in hand of the Treasurer, 31st December, 1901			316 8 7
	Excess of Income over Expenditure, 1902			1 19 5
				£318 8 0

*Annuity of £201 8s. 0d. payable until October, 1914, inclusive, created to repay an advance of £3500 made by the Yorkshire Insurance Co.

Principal repaid	1595 11 11	
„ outstanding	1904 8 1	
	£3500 0 0	

Examined and found correct,

E. GRAY, *Treasurer.* PHILIP L. NEWMAN.

NEW MEMBERS, 1902.

Angus, Joseph C., *Marygate.*
Badcock, A., *Clarence House.*
Badger, H. W., *Clifton Green.*
Ball, Mrs., *Mill Crux.*
Banks, Miss, 89, *Micklegate.*
Barber, Norman R., *Spurriergate.*
Barraclough, E., "*Roseneath,*" *St. Olave's Road.*
Barron, A. H., *Minster Gates.*
Bentley, Wm., *Fulford Grange.*
Birks, E. A., *Minster View, Duncombe Place.*
Biscomb, W. E., 10, *Queen Anne's Road.*
Britton, A. J., 42, *St. Olave's Road.*
Burdekin, C. L., 35, *Parliament Street.*
Clutton, Miss Margaret, *The Mount.*
Dow, J. W., 33, *Sycamore Terrace.*
Felgate, J. H. Palmer, 51, *Holgate Terrace.*
Godsmark, Frank, 102, *Micklegate.*
Gowland, Mrs. J., 13, *Ogleforth.*
Grisdale, John, *Coney Street.*
Guy, J. P., *Lendal.*
Holey, Smith, 32, *Gillygate.*
Jesper, Alfred, 19, *Micklegate.*
Kitching, R. C., 3, *Sycamore Place.*
Lockwood, David, 14, *St. George's Place.*
Martin, Christopher, 3, *Longfield Terrace.*
Mawson, Miss, *Club Chambers.*
Milburn, W. C., Jr., 34, *St. Olave's Road.*
Morrell, J. B., 30, *St. Mary's.*

Nelson, Miss, 15, *Bootham Terrace.*
Norwood, A. B., *The Manor House.*
Nottingham, Rev. E. E., *St. John's College.*
Parker, Tom, *The Gables, Bootham.*
Poad, J. H., *The Priory, Fulford Road.*
Pumphrey, Miss, *County Hospital.*
Smith, Rev. G. H., 23, *St. Mary's.*
Spurr, Herbert, 21, *Bootham Crescent.*
Thornton, J. A., "*Inglecroft,*" *Nunthorpe Avenue.*
Tidswell, Wm. H., 20, *Bootham Crescent.*
Wainhouse, Wm., *St. Sampson's Square.*
Ware, Mrs. H. J., *Driffield Terrace.*
Wilkinson, Mrs., *The Sycamores.*
Wilson, Miss, *St. Olave's School.*
Wilson, J. C., 36, *Coney Street.*
Wilson, Thos, 5, *Coney Street.*
Woodhouse, Mrs., 7, *Burton Place.*

NEW ASSOCIATES.

Clifford, A., 6, *Longfield Terrace.*
Evans, Rev. E. W., *Dringhouses.*
Hutchinson, Rev. R. O., 32, *Lord Mayor's Walk.*
Swan, Dr., 3, *Holgate Terrace.*
Walker, Capt. Edwyn, *Middlethorpe Lodge.*
Wilson, W. J., 34, *Penley's Grove Street.*

NEW LADY SUBSCRIBERS.

Bellerby, Miss, 20, *Ogleforth.*
Bramwell, Mrs., 35, *St. Mary's.*
Buckle, Miss, 4, *The Avenue.*
Buckle, Mrs., 22, *Queen Anne's Road.*

Cooper, Mrs., 23, *East Mount Road.*
Cooper, Miss, 29, *The Mount.*
Dalton, Miss, 16, *Heworth Green.*
Dodd, Miss, *The Dispensary.*
Frank, Mrs., 19, *George Street.*
Harrison, Mrs., *St. Peter's Grove.*
Middleton, Miss Mary, 91, *The Mount.*
Oberhoffer, Mrs., 20, *Grosvenor Terrace.*
Robertson, Mrs., 23, *Sycamore Terrace.*
Routledge, Mrs., 1, *St. John's Crescent.*
Seller, Mrs. J. T., *The Mount.*
Thackray, Miss, 11, *Park Place.*
Thorp, Mrs., *St. James Terrace.*
Webster, Mrs. M., 17, *Layerthorpe.*
Williams, Miss, 3, *Telford Terrace.*

TEMPORARY MEMBER.

Montgomery, D. H., *Portland Street.*

DONATIONS TO MUSEUM AND LIBRARY.

LIBRARY.

Books Presented.	Donor.
The Quarterly Journal of the Geological Society of London, Vol. lviii., 1902.	The Society.
The Report of the British Association for the Advancement of Science, Glasgow, 1901.	The Association.
Transactions of the Zoological Society of London, Vol. xvi., Parts 5, 6, 7; Proceedings, Vol. i., Parts 1, 2; Vol. ii., Part 1; Index 1891 to 1900, and Catalogue of Library.	The Society.
21st Annual Report of the United States Geological Survey, 1899-1900, Parts 2, 3, 4, 5, 7, Maps; Reconnaissances in the Cape Nome and Norton Bay Regions, Alaska, in 1900. The Geology and Mineral resources of a portion of the Copper River District, Alaska.	The Survey.
Catalogue of Fossil Fishes, Part 4, of Lepidoptera Phalænæ and Plates, Vol. iii.; Hand-list of Birds, Vol. iii.; Report on the Natural History Collections, made during the Voyage of the "Southern Cross"; Handbook of Instruction for Collectors; Guide to the Coral Gallery, and set of 40 Lithographic Plates of Westwood's Phasmidæ, 1889.	The Trustees of the British Museum.

18th Annual Report of the Bureau of American Ethnology, 1896-7, Part 2, Bulletin No. 26, and Annual Report of the Smithsonian Institution for 1900.	The Institution.
Memoirs of the Geological Survey of India, "Palæontologia Indica," New Series, Vol. ii., Parts 1 to 7, and General Report of the Survey, 1891-1900.	The Survey.
An account of the Crustacea of Norway, by G. O. Sars; Vol. iv., Parts 3, 4, 5, 6, 7, 8, 9, 10.	The Author.
Proceedings of the Royal Institution of Great Britain, Vol. xvi., Part 3, No. 95.	The Institution.
Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. xlvi., Parts 2, 3, 4, 5, 7, Vol. xlvii., Part 1.	The Society.
The Flora of the East Riding of Yorkshire, by James Fraser Robinson.	H. J. Wilkinson.
Transactions of the Leicester Literary and Philosophical Society, Vol. vi., Parts 1, 2, 3, Vol. vii., Parts 1, 2.	The Society.
Proceedings of the Geologists' Association, Vol. xvii., Part 5.	The Association.
Transactions of the Norwegian North-Atlantic Expedition, 1876-78, Vol. xxviii., Part 3.	The Committee.
Memoirs of the Russian Geological Society, Vol. xv., No. 4; Vol. xvii., Nos. 1, 2; Vol. xviii., No. 3; Vol. xix., No. 1; Vol. xx., No. 2; Bulletin Vol. xx., Nos. 1 to 10, Vol. xxi., Nos. 1 to 4.	The Society.

Proceedings of the Imperial Mineralogical Society of Russia for 1902.	The Society.
Memoirs of the Naturalists' Society of Kiew, Vol. xvii., Part 1.	The Society.
Bulletin of the American Geographical Society, Vol. xxxiii., No. 5; Vol. xxxiv., Nos. 1, 2, 4.	The Society.
The Journal of the Manchester Geographical Society, Vol. xii., Supplement; Vol. xvii., Nos. 7, 8, 9, 10, 11, 12.	The Society.
Proceedings of the Bath Antiquarian Field Club and Natural History Society, Vol. x., No. 1.	The Society.
Contributions to Canadian Palæontology, Vol. ii., Part 2; Vol. iv., Part 2; Catalogue of the Marine Invertebrata of Eastern Canada.	The Geological Survey of Canada.
Annals of the New York Academy of Sciences, Vol. xiv., Parts 1, 2.	The Academy.
The University of Toronto Studies, Nos. 2, 3.	The University.
Summary of Progress of the Geological Survey of the United Kingdom for 1901.	The Board of Education.
Mitteilungen des Vereins für Erdkunde zu Leipzic for 1901.	The Society.
Bergen Museums Aarbog for 1902	The Council.
Oberhessischen Gesellschaft für Natur- und Heilkund 1902; Verhandlungen der Naturforschenden Gesellschaft in Basel, Vol. xiii., No. 3.	The Society.

Records of the Geological Survey of New South Wales, Vol. vii.; Mineral Resources, No. 10; Handbook of the Mining and Geological Museum, Sydney; Report on the Yalwal Gold Field, by E. C. Andrews, B.A.; Annual Report of the Department of Mines for 1900-1901, and Report of the Trustees of the Museum for 1901.	New South Wales Survey.
Nova acta des Kaisl. Carol. Deutschen Akademie der Naturforscher, 1897 to 1901, and Vol. lxxix, No. 3.	The Academy.
Transactions of the Perthshire Society of Natural Science, Vol. iii., Part 4.	The Society.
Report and Proceedings of the Belfast Natural History and Philosophical Society for 1900-1, 1901-2.	The Society.
Glacier-lakes in the Cleveland Hills, by P. F. Kendall.	The Author.
Journal of the Northants Natural History Society and Field Club, Vol. xi., Nos. 85, 86, 87, 88.	The Society.
Transactions of the Academy of Science of St. Louis, Vol. xi., Nos. 6 to 11; Vol. xii., Nos. 1 to 8.	The Academy.
Inventaire des Richesses D'Art.	Minister of Instruction.
Bulletin of the New York Public Library, Vol. vi., Nos. 1 to 11.	The Committee.
Annals of the National Museum of Montevideo, Vol. iv., Part 22.	The Council.
Bulletin of the Geological Institute of Mexico, No. 15.	The Institution.
Bulletin of the University of Kansas, Vol. i., Nos. 1 to 4; Vol. ii., No 7.	The University.

Bulletin of the University of Montana, Summer Birds of Flathead Lake, by P. M. Silloway.	The University.
Annalen des K. K. Naturhistorischen Hofmuseums für 1900.	The Society.
Catalogue of the Minerals in the Passmore Edwards' Museum, West Ham.	The Council.
21st Annual Report of the Board of Trustees of the Ohio State University 1901, Parts 1, 2.	The University.
Symons' Meteorological Magazine for January, 1902.	J. E. Clark.
The 1st Report of the Geological Survey of Natal.	The Survey.
Report of the Meteorological Council to the Roy Society for 1901; Temperature Tables for the British Islands daily means 1871 to 1900, and supplement and weekly weather Reports for 1902.	The Meteorological Society.
Report of the National Astronomical Observatory of Mexico.	The Society.
Bulletin of the Lloyd Library, Nos. 1, 3.	The Library.
Tuft's College Studies, No. 7.	The College.
Publications of the Manchester Museum, Owen's College, Nos. 35 to 40.	The Museum.
Annual Report of the Bradford Libraries Art Gallery and Museum.	The Committee.
Hull Museum Publications, No. 6, by T. Sheppard.	The Author.

GEOLOGICAL DEPARTMENT.

Mountain Limestone Boulder containing specimen of Productus from Acaster.	
Rock specimen from the Bone Bed of Ludlow.	Dr. Auden.

ANTIQUITIES.

A small Patch Box.	Sir C. A. Milward.
A Roman Coin found in High Ousegate.	Mr. Harding.
A Victorian Half-crown piece, 1874.	Mr. J. F. Walker.
Some Elizabethian Silver Coins.	Mr. G. Crawhall.
A few Victorian Silver Coins.	Mr. T. R. Kitching.
A series of Rude Stone Implements from Somaliland.	Mr. H.W. Seton-Karr.
Mummy of an Ibis.	Miss Longridge.
A Map of England, printed on Silk, and dated 1749.	Miss Stevens.

ZOOLOGY & COMPARATIVE ANATOMY.

A clutch each of the Eggs of Golden Plover and Curlew.	Mr. Lazenby.
An adult mute Swan, mounted.	Mr. E. Allen.
6 Cabinets containing over two thousand skins of European Birds.	Mr. J. Backhouse.

MINERALOGY.

A series of Magnesian Limestone concretions.	Mr. Abbott.
A specimen of Talc from the Madras Presidency, India.	Mr. S. L. Wyatt.

CATALOGUE OF BRITISH PLANTS IN THE HERBARIUM

OF THE

YORKSHIRE PHILOSOPHICAL SOCIETY.

PART IX.

COMPILED BY HENRY J. WILKINSON, HON. CURATOR, BOTANY.

ARALIACEÆ.

	DATE.	COLLECTOR.	HERBARIUM.
564. Hedera Helix, Linn.			
Rocks, woods, &c., from Aberdeen southwards.			
Distrib. Europe, W. Asia, &c.			
Sp. York	1806	S. Hailstone	S. Hailstone

CORNACEÆ.

565. Cornus suecica, Linn.			
Alpine Moors, Yorkshire to Sutherland			
Distrib. N. and Arctic Europe, Asia, &c.			
Sp. Hole of Horcum, Pickering, N.E. Yorks.	1800	W. Brunton	S. Hailstone
Hole of Horcum, Pickering, N.E. Yorks.	1807	W. Middleton	W. Middleton
Hole of Horcum, Pickering, N.E. Yorks.	1883	H. J. Wilkinson	H. J. Wilkinson
Ben Lawers, Perthshire	1809	J. Dalton	Rev. J. Dalton
Cross Cliff, near Hackness, N.E. Yorks.	1863	W. Bean	H. J. Wilkinson

	Date.	Collector.	Herbarium.
566. Cornus sanguinea, Linn.			
Hedges and thickets from Westmoreland southwards.			
Distrib. Europe, N. and W. Asia, &c.			
Sp. Near Thirsk, Yorkshire	1806	S. Hailstone	S. Hailstone
Whalley, Lancashire	1807	,,	,,
Langwith, York	1883	H. J. Wilkinson	H. J. Wilkinson

CAPRIFOLIACEÆ.

567. Adoxa moschatellina, Linn.			
Woods and hedgebanks, from Ross southwards.			
Distrib. Europe, N. Asia, N. America.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
Foulbridge, near Colne, Lancashire	1807	S. Hailstone	S. Hailstone
Heslington, York	1882	H. J. Wilkinson	H. J. Wilkinson
568. Sambucus nigra, Linn.			
Hedges and thickets from Ross southwards.			
Distrib. Europe, W. Asia, N. Africa.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
(*var. laciniata, Linn*) roadside between Malton and Scarbro', Yorkshire	1809	W. Middleton	W. Middleton
569. Sambucus ebulus, Linn.			
Hedgebanks, &c., from Caithness southwards.			
Distrib. Europe, W. Asia, N. Africa.			
Sp. Leeming Lane, N. Yorkshire ...	1821	J. Dalton	Rev. J. Dalton
Beyond Pierce Bridge (in Durham)	1822	,,	,,

	Date.	Collector.	Herbarium.
570. Viburnum opulus, Linn.			
Hedges and thickets from Caithness southwards.			
Distrib. Europe, N. and W. Asia, N. America.			
Sp. Heslington, York	1806	W. Middleton	W. Middleton
Clifton Ings, York	1883	H. J. Wilkinson	H. J. Wilkinson
571. Viburnum lantana, Linn.			
Hedges, &c., on calcareous soil from Yorkshire southwards.			
Distrib. Belgium southward, N. & W. Asia.			
Sp. Near Newmarket, Cambs.	1830	J. Dalton	Rev. J. Dalton
Leigh Woods, Somersetshire ...	1810	W. Middleton	W. Middleton
572. Linnæa borealis, Gronov			
Fir forests, &c., Ross to Yorkshire.			
Distrib. Lapland, Arctic, Asia, and N. America.			
Sp. Clova Mountains, Forfarshire ...	1837	Dr. Greville	S. Hailstone
Inglemaldie ,, ...	1838	A. Kenn	,,
Glen Dole ,, ...	1833	Giles Munby	G. Munby
Fir wood, Inglemaldie, Brechin, Forfarshire	1809	J. Dalton	Rev. J. Dalton
Morrone Hill, Braemar, Aberdeenshire	1898	F. H. Weekes	F. H. Weekes
573. Lonicera caprifolium, Linn.			
Copses in Cambridge and Oxford. (Naturalized).			
Distrib. Mid and S. Europe, W. Asia.			
Sp. Ray's field, near Cherry Hinton, Cambs.	1800	J. Dalton	Rev. J. Dalton
Edinburgh	1833	Giles Munby	Giles Munby

	Date.	Collector.	Herbarium.
574. Lonicera periclymenium, Linn.			
Hedges and thickets, Shetland to Channel Islands.			
Distrib. W. Europe.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
Langwith, York	1882	H. J. Wilkinson	H. J. Wilkinson
575. Lonicera Xylosteum, Linn.			
Copses; Sussex, Hertfordshire, &c. (Naturalized).			
Distrib. Europe, N. Asia.			
Sp. Amberley Hacketts, near Arundel, Sussex	1809	J. Dalton	Rev. J. Dalton
Amberley Hacketts, near Arundel, Sussex	1833	Dr. Bromfield	S. Hailstone

RUBIACEÆ.

576. Rubia peregrina, Linn.			
Rocks, copses, &c., near the sea; Sussex, Cornwall.			
Distrib. W. Europe, N.W. Africa.			
Sp. Portland Isle	1830	J. Hailstone	S. Hailstone
Isle of Wight	1840	S. Hailstone.junr.	S. Hailstone
Steep Hill, Isle of Wight	1820	W. Middleton	W. Middleton
577. Galium boreale, Linn.			
Rocky and bushy places, Shetland, York, &c.			
Distrib. N. and Mid Europe (Arctic), N. Asia.			
Sp. Kirkby Lonsdale (Westmorland) ...	1820	W. Middleton	W. Middleton
Rocks at the Strid, Bolton Abbey, Yorkshire	1820	S. Hailstone	S. Hailstone
Winch Bridge, Teesdale, Yorks. ...	1822	,,	,,
Falls of the Clyde, Scotland ...	1829	,,	,,
Teesdale, Yorkshire, and Durham...	Jun.11,1833	Giles Munby	Giles Munby
Cronkley Fell, Teesdale, Yorks. ...	1883	H. J. Wilkinson	H. J. Wilkinson

		Date.	Collector.	Herbarium.
578. Galium cruciata, Scopoli.				
Banks and hedges, Hebrides southwards				
Distrib. From Holland southwards, Siberia, &c.				
Sp.	Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
	Holgate, York	1800	S. Hailstone	S. Hailstone
	Heslington, York	1883	H. J. Wilkinson	H. J. Wilkinson
579. Galium verum, Linn.				
Sandy banks, Shetland southwards.				
Distrib. Europe, N. Asia, Himalaya.				
Sp.	Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
	York	1806	S. Hailstone	S. Hailstone
	Heslington, York	1802	W. Middleton	W. Middleton
	Forfar	1846	S. Hailstone	S. Hailstone
580. Galium erectum, Huds.				
Banks and fields (on chalk), Yorks., Kent, Dorset.				
Sp.	Hovingham, N. Yorkshire	1883	H. J. Wilkinson	H. J. Wilkinson
581. Galium mollugo, Linn.				
Hedges and copses, Perth southwards.				
Distrib. Europe (Arctic), N. Asia.				
Sp.	Tadcaster, Yorkshire	1806	S. Hailstone	S. Hailstone
	Greta Bridge, Yorkshire	1822	,,	,,
	Bottisham, Cambs.	1843	,,	,,
	Heslington, York	1830	H. Ibbotson	H. J. Wilkinson
	Langwith ,, ...	1883	H. J. Wilkinson	H. J. Wilkinson
	Snailwell, Cambs.	1806	J. Dalton	Rev. J. Dalton
582. Galium saxatile, Linn.				
Rocks, heaths, &c., Sutherland to Channel Islands.				
Distrib. W. Europe, Iceland to N. Italy.				
Sp.	Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
	Knavesmire, York	1803	S. Hailstone	S. Hailstone
	Langford Moor, Newark, Notts. ...	1806	W. Middleton	W. Middleton
	Strensall, York	1883	H. J. Wilkinson	H. J. Wilkinson

	Date.	Collector.	Herbarium.
583. Galium sylvestre, Poll.			
Dry rocky hills and pastures from Orkney to Dorset.			
Distrib. Mid & W. Europe, Iceland, &c.			
Sp. Malham, Yorkshire	1799	S. Hailstone	S. Hailstone
Ingleton ,, ...	1830	O. A. Moore	O. A. Moore
Cronkley Fell, N.W. Yorkshire ...	1883	H. J. Wilkinson	H. J. Wilkinson
Cheddar Pass, Somersetshire ...	1884	H. Fisher	H. J. Wilkinson
584. Galium palustre, Linn.			
Marshes and ditches, Sutherland to Channel Islands.			
Distrib. Europe (Arctic), N. Africa.			
Sp. Coatham, N.E. Yorkshire	1800	S. Hailstone	S. Hailstone
Loch Lomond (Stirling)	1829	S. Hailstone	,,
Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
585. Galium uliginosum, Linn.			
Marshes and ditches from Caithness southwards.			
Distrib. North and Mid Europe (Arctic), N. Asia.			
Sp. Ripon, Yorkshire	1800	W. Brunton	S. Hailstone
Bottisham Fen, Cambs.	1843	S. Hailstone	,,
Langwith, York	1883	H. J. Wilkinson	H. J. Wilkinson
586. Galium anglicum, Huds.			
Walls and sandy places, S.E. England.			
Distrib. From Holland southwards, Canaries to Persia.			
Sp. Norfolk	(1800)	G. Don	S. Hailstone
Norwich, Norfolk	1830	J. Dalton	Rev. J. Dalton
587. Galium Vaillantii, D.C.			
Sp. Saffron Walden, Essex	1848	G. S. Gibson	S. Hailstone

	Date.	Collector.	Herbarium.
588. Galium aparine, Linn.			
Hedges and waste places, Shetland to Channel Islands.			
Distrib. Europe (Arctic), N. Africa, N.W. Asia.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
York	1806	W. Middleton	W. Middleton
589. Galium tricorne, With.			
Cultivated fields on chalky soil, from Cumberland southwards.			
Distrib. From Holland southwards, N. Africa, &c.			
Sp. Thorparch, Yorkshire	May, 1830	S. Hailstone	S. Hailstone
Cornfield, Hildenly Wood, N. Yorks.	1806	W. Middleton	W. Middleton
590. Asperula odorata, Linn.			
Hedgebanks and copses, &c., Shetland to Channel Islands.			
Distrib. Europe (excl. Spain), N. and W. Asia.			
Sp. Bingley, Yorkshire	1806	S. Hailstone	S. Hailstone
Malham Cove, Yorkshire	1832	,,	,,
Studley, Ripon ,, ...	1790	Rev. J. Dalton	Rev. J. Dalton
Helmsley, N. Yorkshire	1883	H. J. Wilkinson	H. J. Wilkinson
591. Asperula arvensis, Linn.			
Alien.			
Sp. Devonport	(1810)	W. J. Hooker	Rev. J. Dalton
592. Asperula cynanchia, Linn.			
Dry banks, from Westmoreland and York southwards.			
Distrib. Holland to N. Africa, N.W. Asia.			
Sp. Bramham, Yorkshire	1830	S. Hailstone	S. Hailstone
Knaresboro' ,, ...	,,	,,	,,
Ripon ,, ...	1800	W. Brunton	,,
Ripon ,, ...	1800	J. Dalton	Rev. J. Dalton
Huddleston Quarry, N.W. Yorks....	1883	H. J. Wilkinson	H. J. Wilkinson
Knaresboro', Yorkshire	1900	H. Fisher	,,

	Date.	Collector.	Herbarium.
593. Sherardia arvensis, Linn.			
Fields and waste places, Caithness to Channel Islands.			
Distrib. Europe, N. Asia, &c.			
Sp. Kirkstall Bridge, Leeds, Yorkshire			
In the fields at the Cliff and near Bolton (Bradford, Yorkshire) ...	1804	S. Hailstone	S. Hailstone
Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
Heslington, York	1820	W. Middleton	W. Middleton

VALERIANEÆ.

594. Valeriana dioica, Linn.			
Wet meadows and swampy places, Fife to Cornwall.			
Distrib. N. and Mid Europe, Himalaya.			
Sp. Thorparch, Yorkshire	1849	S. Hailstone	S. Hailstone
Shipley ,, ...	1806	,,	,,
Copgrove ,, ...	1790	J. Dalton	Rev. J. Dalton
Heslington ,, ...	1800	W. Middleton	W. Middleton
595. Valeriana officinalis, Linn.			
Wet meadows and banks of streams, Orkney to Channel Islands.			
Distrib. Europe (Arctic), N. and W. Asia.			
Sp. Thorparch, Yorkshire.	1840	S. Hailstone	S. Hailstone
Copgrove ,, ...	1790	J. Dalton	Rev. J. Dalton
596. Valeriana pyrenaica, Linn.			
(alien.) Naturalized in plantations.			
Sp. Edinburgh	1833	Giles Munby	Giles Munby
597. Centranthus ruber, D.C.			
Old walls and chalk pits (naturalized)			
Sp. Kent	(1800)	W. J. Hooker	Rev. J. Dalton
Near Dover, Kent	(1800)	D. Turner	,,

	Date.	Collector.	Herbarium.
598. Valerianella olitoria, Mœnch.			
Cornfields and hedgebanks, Shetland to Channel Islands.			
Distrib. Europe, N. Africa, N. Asia.			
Sp. Cliff fields and Bolton fields, near Bradford, Yorkshire	1804	S. Hailstone	S. Hailstone
Boston Spa, Yorkshire	1832	,,	,,
Hastings, Sussex	1832	,,	,,
Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
599. Valerianella carinata, Loisel.			
Cultivated ground (Naturalized.)			
Sp. Longlane, Church Stretton, Shropshire	(1844)	W. R. Crotch	S. Hailstone
Copgrove, Yorkshire ... ... (*sub nom dentata*).	1790	J. Dalton	Rev. J. Dalton
600. Valerianella auricula, D.C.			
Cornfields, &c., Fife southwards (Colonist ?)			
Sp. Croft, North Yorkshire	1830	J. Dalton	Rev. J. Dalton
601. Valerianella dentata, Poll.			
Cornfields from Lanark southwards (Colonist ?).			
Sp. Hastings, Sussex ... ... (*sub nom F. auricula*)	1834	S. Hailstone	S. Hailstone
Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton

DIPSACEÆ.

602. Dipsacus sylvestris, Linn.			
Copses & hedges from Perth southwards.			
Distrib. From Denmark southwards.			
Sp. Saltburn, N.E. Yorkshire	1799	S. Hailstone	S. Hailstone
Grantchester, Cambs.	1840	,,	,,
Retford	1820	W. Middleton	W. Middleton
Skeffling, S.E. Yorkshire	1893	H. J. Wilkinson	H. J. Wilkinson

	Date.	Collector.	Herbarium.
603. Dipsacus pilosus, Linn.			
Moist hedges and banks, Yorkshire to Devon, &c.			
Distrib. N. and Mid Europe.			
Sp. Ulverstone, Lancashire	(1830)	Mr. Hustler	S. Hailstone
Devil's Ditch, Cambs.	(1840)	Miss J. Hailstone	,,
604. Scabiosa succisa, Linn.			
Pastures and waysides, Shetland to Channel Islands.			
Distrib. N. and Mid Europe (Arctic), N. Africa.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
Thorparch ,, ...	1830	S. Hailstone	S. Hailstone
605. Scabiosa columbaria, Linn.			
Dry Pastures and banks, Perth to Channel Islands.			
Distrib. Europe, Mediterranean region.			
Sp. Clitheroe Castle, Lancashire ...	1808	S. Hailstone	S. Hailstone
Bridlington, Yorkshire	1820	,,	,,
Copgrove ,, ...	1790	J. Dalton	Rev. J. Dalton
Heslington, York	1883	H. J. Wilkinson	H. J. Wilkinson
606. Scabiosa arvensis, Linn.			
Dry banks and fields, Orkney to Channel Islands.			
Distrib. Europe (Arctic), Caucasus.			
Sp. Copgrove, Yorkshire	1790	J. Dalton	Rev. J. Dalton
Heslington, York	1820	W. Middleton	W. Middleton

"SEA SAND."

A Lecture before the Yorkshire Philosophical Society, Dec. 1902,

By HUGH RICHARDSON, M.A.

THROUGHOUT all ages the star-spangled heavens and the lonely seashore have impressed the spirit of man with a sense of the infinite. In speaking of the descendants of Abraham, generation after generation has employed the same formula—"So many as the stars of the sky in multitude and as the sand which is by the sea shore innumerable." Attempts have been made to count the stars. In our English skies and without a telescope only some 3000 are visible to the naked eye. Over 300,000 have been catalogued as easily visible through a telescope, and vastly larger numbers are now being registered on photographic plates. A high magnifying power turned on the Milky Way suggests unnumbered millions. The questions whether the number of the stars is really infinite, whether the material universe has finite boundaries, or stretches on for ever a shoreless sea where the light waves never break on any margin—these questions may be asked, but their consideration would take us off our safe shores of time and space into the deep waters of philosophy.

Let us turn to something simpler. How many grains of sand would fill a cubic inch? Well, a not uncommon size for fine sand is $\frac{1}{100}$ inch in diameter. Suppose 100 such grains in a row, they would stretch for 1 inch; or on a square inch 100 times 100, or 10,000 might be laid; and piling up 100 such layers we have 1,000,000 grains to the cubic inch—more grains of sand in a handful than stars numbered in the catalogue.

In the fairy tale of Ashputtel, the wicked stepmother threw the dish of peas into the ash heap, and then told her poor

stepdaughter to get them all picked out in two hours time if she wished to go to the dance. The birds of the air came to help her, and long before the allotted time peas and cinders were disentangled. We have tried to disentangle the still greater confusion in a handful of sand. And if it be suggested that we should pick out the large or the small grains, the hard or the soft, the light or the heavy, the flat or the round, the limestone, the iron or the flint, to all these problems we shall offer at least partial answers.

The experiments described below have mostly been worked out by my pupils at Bootham School. They are of an elementary character. At first sight some may seem simply silly, others trivial and useless. Advanced methods of chemical and microscopic analysis have been beyond our reach; but there are certain vistas of interesting inquiries which open out as soon as we begin to apply commonsense methods to the investigation of everyday things. Many of the experiments are still only in process, and are mentioned as suggestive not as conclusive. My special thanks are already due to Mr. Walker and Mr. Platnauer for their kind assistance, as well as to the publications of Prof. Warrington, Prof. Karl Pearson, and Mr. Francis Galton.

The statements in the school books that sand is silica, and that sea sand is formed by the wearing away of sea cliffs, have sometimes seemed so simple and so final that we have been tempted to accept these conclusions and to rest in them without further thought.

Our inquiries were prompted by a winter sojourn at Scarbro', and have been directed mainly to the sand of the Scarbro' South Bay. A glance at a handful of this shows at once that it consists of very various colours. Its nature then is complex not simple.

A dishful of sand brought home from the shore may appear dry, but if a small quantity of it is heated in a test-tube and then poured out, some of it sticks to the side of the tube. Moisture has been given off from the sand, and condensing in the upper part of the tube has retained some of the grains. Apparently sand which seems dry may contain water.

The drying may be more completely effected in an open evaporating basin, the sand being stirred with a test-tube of cold water until it no longer adheres to the outside of this tube. A sample of such dried sand was first cooled in dry air, then weighed, and left exposed to the atmosphere; it gained weight. It is reasonable to suppose that some sea salt was on the surface of the grains of sea sand, and that just as the properties of sea weed (changing wet or dry with the weather) appear to depend upon the sea salt on its surface, so perhaps the sea sand may change its weight with the moisture of the air. But this we have not proved.

The familiar spade and bucket experiment of moulding sand into sand pies depends for its success on the grains being slightly damp. Really dry sand is quite loose, and foundry sand is purposely made damp for moulding.

The suspicion that salt exists on the surface of sand can easily be verified. We have only to compare the result of running some distilled water through a clean filter paper and some more water through unwashed sea sand. The milky cloud in the presence of silver nitrate reveals the difference usually attributed to sodium chloride. But here let us beware lest because the school books call common salt sodium chloride we should rashly conclude that it is the sodium chloride on the salt grains which keeps them moist. There are many salts in sea water, and the damp detaining properties may be chiefly due to magnesium or calcium compounds, either alone or in conjunction with sodium chloride. It is, I believe, this damp detaining power which, in conjunction with its roundness, disqualifies sea sand for making mortar.

So far then we find that sea sand contains water and salts as well as sand. Now for the sand.—

We have worked with sand washed free from salt and then dried. A curious change of tint occurs in the drying if the temperature gets needlessly high, the yellow tinge changing to pink, but of this more presently.

We have inquired into the size of sand grains. These are most conveniently measured by strewing them on a micrometer—a sheet of glass ruled with lines $\frac{1}{1000}$ of an inch apart —which may then be observed through the microscope. The

diameters in some fine Scarbro' sand run from $\frac{1}{20}$ inch to less than $\frac{1}{100}$ inch. But different samples of sand are of obviously different fineness. Thus from Thornwick Bay, near Flambro', comes a much coarser sample of angular flint sand, the particles being about as coarse as fine shot.

Another plan was to scatter a known weight or volume of sand evenly over a sheet of paper, ruled in squares, and by counting the numbers of grains on a few squares to estimate the total number.

In any small portion of the sand, as it lies on the shore, the grains are generally of about the same size—that is, fine mud and coarse gravel are not as a rule mixed with it.

When such a natural sample of sea sand is thrown into water, the particles sink at not very different rates. This is because the sand has already been water sorted. The finer particles have been carried away altogether. The gravel has settled previously, and the sand falling later has partly filled the interstices of the gravel and also formed a layer on top of it. The swift currents round a cape leave only large blocks of stone; in exposed bays like Cornelian Bay, gravel is left; in Thornwick Bay near the Flamboro' headland, a coarse sand; in the sheltered Scarboro' South Bay, a fine sand; but even there the finer mud has been carried away.

At high Spring tides when the waves reach the clay banks, the sea is muddy for a hundred yards or so from the Scarboro' cliff banks, and some of this mud is left in the rock pools from which it is afterwards swept away by succeeding tides.

There are other ways in which sand may get sorted into sizes. If a dish of dry sand and gravel is shaken, the sand will shake down through the interstices of the gravel. So although gravel settles first in water, the sand may afterwards find its way down among the interstices of the gravel. Digging into the Scarboro' sand below the Holbeck Gardens, I have found first a layer of fine sand and then underneath this mixed sand and gravel.

At the Gravel Pits beyond Fulford, when a various mixture of sand and gravel is tipped out from the truck, the larger stones collect at the bottom of the heap. This is because the irregularities of the heap are rough relatively to sand grains

(which are therefore detained), but smooth compared to the larger stones (which therefore roll to the bottom). When rain falls upon a heap of sand and gravel, the sand goes to the bottom whilst the gravel remains, because the rain is able to wash away the finer grains, but does not stir the heavier stones. On the Northumberland coast, after a strong wind off shore, I have seen a plain swept almost bare of sand, leaving the gravel in coarse ripples a yard or so apart.

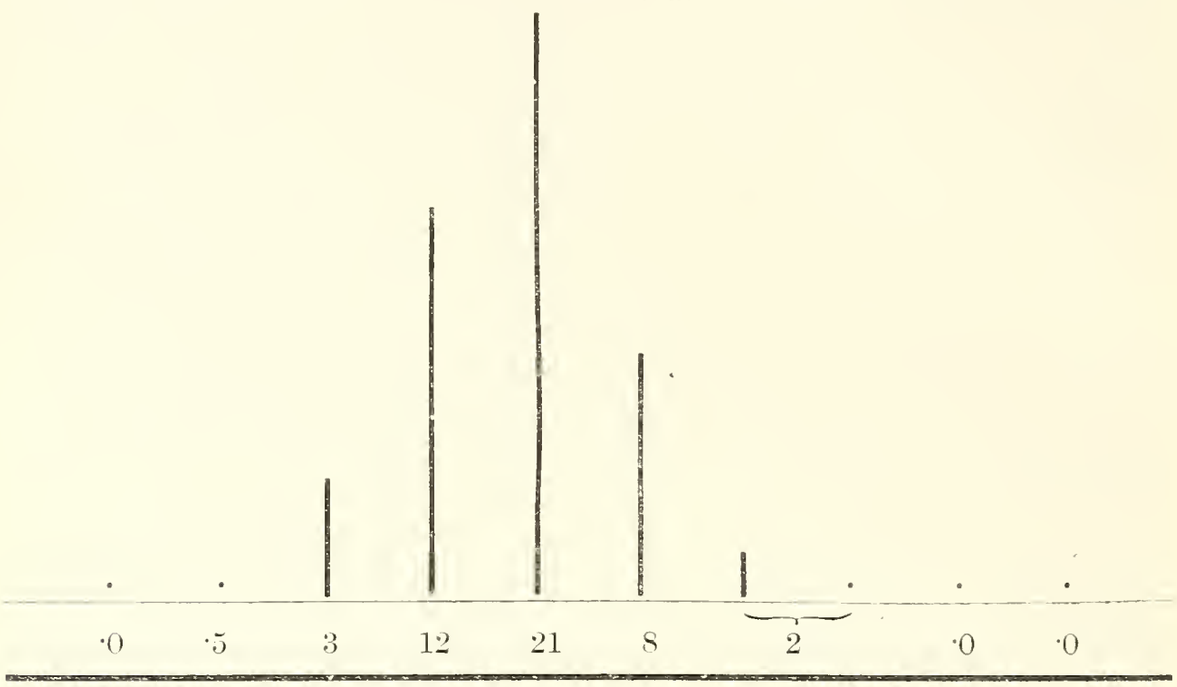
In comparing the fineness of two different samples of sand, it is not necessary to actually measure the grains. We have found it convenient to divide the sand into grades of fineness by means of a series of graduated sieves. These are made (in Stonegate and elsewhere) from wire gauze, so as to have 10, 20, 30, or some other number of holes to the linear inch. 20 holes to the inch does not imply that particles $\frac{1}{20}$ inch in diameter will just slip through. The wires have some thickness, and such particles would not get through. Perhaps the most useful sizes are 30, 60, and 90 to the inch. But the complete set we have used runs from 10 to 90 (omitting 70). Using these, a sample of sand may be separated into some 10 different grades. (I have allowed for the lack of a 70 sieve by splitting the 60 to 80 grade of sand into two arbitrary portions).

A sample of sand has been passed through the whole series of sieves, and the quantities rejected by each sieve have been transferred to upright measuring jars so that their volumes may be compared.

Rejected by	10	20	30	40	50	60	70	80	90	—
Passed by..	—	10	20	30	40	50	60	70	80	90
Volume ..	·0+	·5	3·	12·	21·	8·	2·		*very little*	*still less*

If the 40 to 50 grade is the largest portion, then the adjacent grades 30 to 40 and 50 to 60 are the next commonest, and the two extreme grades (rejected by 10, and passing 90) are the rarest. This sounds common sense. It is like saying that most of the sand has a diameter not very different from the average diameter. But there is more in this orderly

arrangement than appears at first sight. Let us make a diagram showing by the heights of vertical lines the quantities of sand in each jar in order,



and then imagine a curve drawn through the tops of the lines. Now a curve of this volcano-shaped form happens to be very celebrated. It is well known to mathematicians. A rudimentary knowledge of it follows from the binomial theorem, but its properties are more completely discussed in the integral calculus. It turns up in all sorts of investigations. This experimental illustration of a general law has been worked out as one of the most elegant instances which I can find to illuminate a principle of far reaching significance.

Consider what possible resemblance there could be between the following sets of statistics—(1) the marks of candidates for admission to the Royal Military Academy at Woolwich, (2) the statures of men in inches, (3) the erroneous results of schoolboys' experiments on latent heat, (4) the number of peas in a pod, (5) the diverse lengths of guillemots' eggs. But in every one of these cases the statistics can be thrown into the form of this curve. For instance, the vertical lines (or more exactly the areas between them) may stand for the numbers of examination candidates whose marks fall within certain limits. The curve comes to us by the application of the theory of probability to the errors of astronomical observations. It has been called the curve of distribution of errors. Mr. Francis

Galton in his "Natural Inheritance," has used this curve to study the problems of heredity; and for this and other work the Royal Society has just awarded the Darwin medal to him. Dr. Russell Wallace has suggested, and Prof. Karl Pearson has greatly developed the use of the curve for the exact study of variation in animals and plants. But we must leave the further discussion of this to the York Naturalists.

For us the curve indicates the proportions between sand particles of different grades which will be deposited side by side. If you like, it indicates the error in the water deposition method of attempting to sort sand into different sizes. The grains differ in shape, in size, in density, and these small differences must affect and may combine to equalize their rates of fall. The history of any single grain is a long chapter of accidents, that is of causes which defy our powers of analysis.

The long chain of causes which brought certain grains of sand into the laboratory is as intricate as that other chain of causes which brought together certain people to consider its properties. Trace back the individual life histories of the inquirers and their family histories for a thousand generations, and consider what innumerable causes have conspired to concentrate them into one room. The curve described above stands for the law of error, the rule of accidents, the order in chaos. The mathematical theory of it is worked out on the hypothesis of an infinite of infinitesimal causes all equally probable. The word *calculus* once meant a pebble: now it applies to a branch of mathematics in which the pebbles are ground finer than the finest sand, though the total of sand is still equal to the pebbles from which it was made.

But if we submit our sand to any new series of accidents we shall get a result of the same form, provided the causes are very many, equal in magnitude and equally probable. For instance, if a stream of fine sand is allowed to fall on a series of horizontal sheets of wire gauze placed one above the other, each grain as it strikes the wires may be turned just in or just out of the meshes, or bouncing may be thrown still further out. The first grains that fall are laid out like bullet marks on a target, most numerous near the middle, fewer towards

edges. As more grains follow, they pile up in the middle making a low volcano shaped cone, until the pattern is spoilt by the middle parts beginning to slide and forming a cone of constant angle as often happens with a cinder cone.

Some of the mathematical problems suggested by the sand grains are similar to those which occur in the theory of molecules. The diagram of the bullet marks on the target is familiar in the Kinetic theory of gases, although in that case the discussion concerns the distribution of diverse velocities among the molecules. More recently Prof. Osborne Reynolds has used the properties of sand to suggest that possibly not only matter but also ether behaves as though it had a granular structure.

The size of the sand grains determines the size of the spaces between them; and many of the properties of sand depend upon these intervals. We have attempted to get some measure of these interspaces by finding how much water they will hold. A dry measure of 100 cubic centimetres of sand is somewhat indefinite unless the sand be well shaken together; for under judicious shaking the volume will be diminished as the particles pack closer together. A similar closer packing occurs with spherical lead shot.

A 200 cc. measuring jar was half-filled with water up to the 100 cc. mark, and a measured 100 cc. of sand poured in. If there were no interspaces the total volume would have been 200 cc., but the total fell short of this by some 30 to 40 cc., showing that about $\frac{1}{3}$ of the dry sand had been air-space.

This fraction is not the same for different kinds of sand. Can we predict whether it will depend on the size or shape of the grains? Will small shot or large shot allow most air-space? or round shot or angular sand? and what about a mixture of many shapes and many sizes?

Fig. 1.

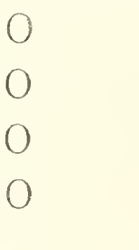


Fig. 2.

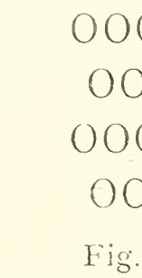


Fig. 3.

Since Fig. 1 will do equally well for large shot, seen at a distance, or for small shot seen through a magnifying glass, we may argue that at any rate the interspaces are the same fraction of the whole in either case. But if the pattern of the packing is different as in Fig. 2, and the spheres are closer together, a mathematical inquiry should show what different volumes of water could be contained in each case. But even on the tightest packing there is room for very small particles between the large ones, and therefore we have an *a priori* suspicion that a sand of mixed grades will fill space more completely than another of uniform grain.

Experimentally we find that shot whether larger (2·8 mm. diam.) or smaller (1·9 mm. diam.) will really fill about 62% of the space which it occupies, leaving 38% of the space which may be filled with water, the size of shot making no difference, provided they are all of the same size.

The Thornwick Bay sand—a coarse very angular sand of even grade—gave results very nearly the same; 7 experiments giving figures between 36 and 39, and thus suggesting that the *shape* of the sand makes but little difference to the interspaces. The coarse Bedfordshire sand used by gardeners has rounded particles which differ considerably in size. This contains much less water, the answers lying between 29 and 33, and averaging 31 per cent. This bears out the suggestion that in a sand of uneven grade, the finer particles would fill up the spaces between the larger.

When wet sand is allowed to drain, some, but not all, of the water runs away. Our next experiment with funnel and graduated jar is to measure the water detained by the sand, and here we find a curious difference from the figures just quoted. The Thornwick Bay sand which contains the more retains the less on draining, and the Bedfordshire which can only contain 31% seems able to detain it all.

This brings us to another property evidenced by the sand—the retaining power which narrow spaces have for water. This is called capillarity, and may be illustrated by the power of blotting paper to absorb ink. In Germany fine sand is often used instead of blotting paper.

Not only does sand retain water, but water will even rise up through sand against the force of gravity. An upright tube was filled with white sand from Huttons Ambo, into which a very little blue black dye had been mixed. The lower end of the tube was placed upright in a basin of water, and the water gradually rose dissolving the dye and blackening the sand. The distance which the water was able to rise—11 inches—suggests that this sand behaves as a labyrinth of passages a little over $\frac{1}{500}$ inch across; the height to which the water rises being an indirect means of measuring the breadth of the passages.

To find whether sand really has been formed by the wear and tear of the coast-line, we must examine the material of the grains. A good example is the flint sand at Thornwick Bay, apparently derived from the bands of flint which occur in the chalk cliffs, and which are so well seen when visiting the Flamboro' caves by boat. But be it noted that whilst the cliffs are almost all chalk with only a few narrow bands of flint, the sand is almost all flint with only a few white chalk pebbles. The softer chalk has worn away far faster than the hard flint. In Cornelian Bay, near Scarboro', are certain patches of red purple sand close beside a red band in the rocks, and in Scarboro' South Bay the sand, yellowish on the whole, corresponds to the yellow colour of the oolite rocks. So that we may take it as at least partly true that sand has come from the cliffs near at hand. But there are also dark particles in the Scarboro' sand which do not suggest any of the adjacent rocks, and if these dark particles are not of local origin, we may have to re-open our inquiry into the yellow ones.

On the supposition that sand is in continual process of being made, and of wearing away, then the smaller grains might say to the larger—"I was what you are, and what I am you shall be"; but with the proviso that the softer material will be the sooner reduced to dust and mud and carried out to sea, so that the residue left on the shore will represent chiefly the harder particles.

Let us explore the history of the sand by considering the gravel, for example that of Cornelian Bay which has long

been remarkable for the great variety of its pebbles—notably the occasional cornelians and agates.

An attempt to arrange these pebbles as a geological collection at once shows that there are many dozens of different sorts—the difficulty is perhaps to find any two that exactly match—and yet they can be arranged in about half-a-dozen main groups. The cup of poison which Medea spilt must have contained some acid, for it made the marble pavement hiss and bubble; and the Geologist's test for marble or any other sort of limestone is to place a drop of hydrochloric acid on the stone, and notice whether any bubbling occurs. This test allows us to quickly pick out the limestone pebbles from among the gravel, and some sorting done in this way indicates that about 1 pebble in every 6 is a limestone of some sort. Other large groups that can be picked out are the sandstones, the quartzites, some dark stones possibly basalt, and a variety of stones of mottled texture which appear to be either granite or other stones of igneous origin.

Geologists say that some of these granites are unlike any British rocks, but resemble certain Scandinavian granites. If so, their presence here can only be explained by supposing that they have been brought upon ice at a time when our islands enjoyed a climate like that of Greenland to-day.

The Scarboro' cliffs are all capped with clay, glacial clay full of pebbles. The seabanks are undrained, and the clay is very wet in winter, so that it is in continual slow glacierlike movement—a movement which threatens to carry away the promenade down towards the sea. On reaching the shore the waves either wash away the clay or cover it with sand.

On treating a sample of this clay so as to wash away the finer portions, a considerable quantity of sand and grit is left. Here is one source of sand other than the rock of the cliffs. Larger stones emerge from the clay at times, among which scratched and polished boulders of the mountain limestone are not infrequent. Isolated blocks weighing some hundredweights are frequently seen littered across the rocky reefs along the coast. The largest I know, a rock called the Dutchman, which must weigh many tons, stands amidst the sand at Newbiggin-by-the-Sea.

In a series of papers by Prof. Lamplugh, published in the Proceedings of the Yorkshire Geological and Polytechnic Society, some account is given of the larger boulders found along the coast near Flamboro'. He enumerates carboniferous limestones, carboniferous sandstones, and basalt, as the commonest of these, with distinctly smaller proportions of granite and quartzite. My impression is that in the Cornelian Bay gravel the granite and quartzite are more conspicuous than amongst the boulders, and if so, this is probably on account of their great hardness.

We can continue the grinding process begun by the waves by rubbing down some sand in a mortar, and washing away the finer particles. This still leaves a large proportion of a very hard powder, hard enough to scratch glass. This is the silica, and if sand is largely silica, it is because silica being extremely hard wears down slower than other materials. To powder the silica itself, we heat it to redness in a platinum crucible and throw it into cold water. After this it is easily broken up, and shows under the microscope as sharp angular transparent splinters.

But Scarboro' sand is not all silica: it contains limestone as well. Whitby sand and River Ouse sand also contain limestone. But the Bedfordshire and Calais sands are practically free from limestone, and so are the sand beds found in the ground in several places near York; the yellow sand excavated for the Railway Company near the Waterworks; the sand dug out to make mimic earthworks on Strensall Common; the fertile orange sand from Messrs. Backhouse's Gardens at Cattal, and the beautiful white sand from Huttons Ambo.

The York Glass Works have made special efforts to secure a pure silica sand for making white glass, and are rewarded by the sand from Fontainbleau, near Paris, quoted at 99·8 per cent. pure silica.

We have attempted to measure the amount of limestone in Scarboro' sand. The fraction dissolved out by acid is variable, and appears to depend on whether that acid is weak acetic dissolving carbonates only, or strong, hot hydrochloric, dissolving other substances as well.

We have therefore tried to determine the limestone by an indirect method, measuring in a Hempel burette the volume of carbon dioxide gas, produced during effervescence. From a few rough experiments it appears that about $\frac{1}{15}$ of the sand is limestone.

It was Mr. Edward Worsdell, of this city, who first pointed out to me that Scarboro' sand contains particles which a magnet can extract. In winter when the sand is damp it will cling to anything, so the experiment is best tried with sand which has been washed free from salt and then dried. If a powerful magnet is trailed through this it will come out bristling with black particles. Under the microscope these appear rounded, glossy-black and highly polished. In seeking for their origin we have examined the purple-red sand of Cornelian Bay, because its colour suggests iron; and here we find the crop of attractable particles unusually rich. In fact, time after time, a magnet can be passed through a handful of sand, and will go on bringing out particles, so that even at the end of an hour, when a yield of 2 or 3 per cent. has been obtained, the supply does not seem exhausted. It would seem however, that the particles are not all equally attractable.

On examining the density of this red sand, it is found to be about $3\frac{1}{2}$ times as heavy as water; whilst the yellow sand of the South Bay is only about $2\frac{1}{2}$ times (more exactly 2·63) as heavy as water.

Moreover if some red sand which has been nearly cleared of its magnetic particles is heated to redness, it will again yield a luxuriant crop. Indeed on very strongly heating it almost all becomes attractable. A smell of burning sulphur during the process suggests that we may be dealing among other things with a sulphide of iron. The particles extracted after heating are not so brilliantly black as those first obtained.

We have not found out for certain the exact composition of either the shining black or the duller particles. They can hardly be metallic iron which would rapidly rust on alternate exposure to air and sea water. Mr. Platnauer has found that the portion extracted by a magnet consists of Magnetite with some Hæmatite, a little Chromite and Pyrrhotine (magnetic pyrites). He also points out that Hæmatite is only

slightly magnetic, but becomes strongly so after being heated; while Pyrites is only magnetic after ignition, when it loses sulphur and becomes converted into Pyrrhotine. Magnetite certainly occurs in the basalt of the North of England.

The word *attractable* has been used because a piece of iron may be attracted by a magnet without being itself a magnet. A good test for a magnet is to find whether it can repel as well as attract another magnet, and a compass needle makes a convenient test magnet. Now at first the shining black particles do not appear to have this power of repulsion. But if a small glass tube full of them is held in the neighbourhood of a strong magnet, and there gently shaken, the tube full of particles will then behave as a magnet attracting one end of a compass and repelling the other. I argue then that the particles have really been *magnetic* all the time, though this is not evident so long as they are arranged anyhow; but that the gentle shaking in the neighbourhood of a strong magnet allows them to arrange themselves all in the same way, and that after this arrangement has taken place their united effect is appreciable.

The existence of any large mass of magnetic material along a coast line may have a disturbing effect on ships' compasses. After a recent shipwreck there were two stories—the captain's which alleged that his compasses were at fault, and another which pointed to errors of observation or judgment due to Alcohol. The supposed causes, do not exclude each other, but their coincidence may well be fatal to safe navigation. I have no evidence, however, that any such magnetic perturbation occurs off the Scarboro' coast.

Nor are these magnetic particles the only iron in the sand. Many yellow sands when boiled with acid lose some of their colour and turn whiter. The yellow substance passes into solution, and this solution may be examined for iron in another way. The test is one of great celebrity. It has been the means of reviving the writing in some of the most ancient Biblical manuscripts. For instance, when Rendall Harris went from Cambridge to explore the library in the monastery on Mount Sinai, he knew that the monks would not approve of his borrowing their manuscripts. Therefore he took

with him a photographic camera and a supply of potassium ferrocyanide.

Brown faded writing still contains the iron of the ink, and if it is brushed over with a weak solution of this potassium ferrocyanide, the letters appear again distinct and blue. And so examining this solution of sand by adding a few drops of potassium ferrocyanide, a bright Prussian blue colour appears which we regard as proof of the presence of iron. The yellow sands generally contain iron, staining the grains of quartz, and it appears to be this yellow iron compound which changes to pink when Scarboro' sand is strongly heated. Presumably the change is by loss of water from some hydrate of iron to ferric oxide. The green colour of common glass is due to ferrous oxide derived from sand containing iron, and it is to avoid iron that makers of the best glass take such pains to secure a pure white sand.

There are other metals besides iron for whose presence we have not yet searched. Nor has our microscopical examination of sand gone much further than admiration of the magnificently polished appearance of the grains when seen by reflected light. A further interesting inquiry would be to use certain very dense liquids to sort out the grains of sand according to their specific gravities.

We have just noticed the influence of shape on the rate at which sand falls through water. The thin flat fragments of shell and the little flashing flakes of mica fall slower than the rounder grains, and therefore come to lie on the surface. In many sandstone rocks the mica flakes lie in planes, and it is along these planes that the rock splits most easily.

The grains may be roughly sorted by shape, by shaking them on a sloping glassplate when the rounder ones tend to run off first. It is, of course, only a rough sort of artificial selection process, but if those that run off the plate are put through the process again and again, we obtain at last a small quantity of sand so round and so mobile as to run about almost like drops of mercury.

A round sand grain will probably run before the wind better than a flat one, and I suspect that sandhill sand may prove of rounder quality than seashore sand. This is certainly true of two samples gathered from the Northumberland coast, a little north of Newbiggin-by-the-Sea; and Calais sand (which I suppose to be from the French sandhills) lacks the flat shell

fragments of Scarboro' sand. I suspect that the rain washes the salt out of sandhills, making the sand habitable for plants, and that ages of percolating water might also remove the less soluble limestone. It is remarkable that the limestone is practically absent in the beds of sand already referred to at Strensall, Catton, Sand Hutton, and near the York Waterworks.

Not very long ago, a few winged words whispered in the audience reached the ear of a lecturer. The speaker wondered what the poor man did it all for, perhaps it was his hobby. In the present case it is partly the poor man's hobby, and partly he is daily concerned in trying to use the methods of scientific research as a means of education. It is not here proposed to weigh the relative values of Science and of Literature. What gives Science its dignity in the curriculum is that it is a part of a larger whole. As an element of instruction Science has been praised for having added to the older comforts of life, the telephone, the motor car, and the lyddite shell; and as helping to maintain the commercial supremacy of every nation that has not learnt to measure a man's wealth by the multitude of things which he can do without.

Instead of dwelling on the triumphant achievements of Science in the recent past, it has seemed wiser to get our pupils to tackle for themselves some real inquiries, however trivial, in which the answer is not a forgone conclusion.

Because apart from the results of Scientific inquiry, the process and methods of research are slowly but profoundly influencing the habits of thought in our age. The great care spent in avoiding errors, the patient repetition of experiments, the averaging of results, the tentative hold on final figures, the fertile use made of imagination and theory to illuminate and explore the surrounding darkness, whilst judgment on the truth of such theories is still suspended—all these influences are conspiring to spread a philosophic tone and temper of thought which must breed a different attitude of mind to the far greater problems, political, social, and religious, which stretch unsolved before us, and to which we are still as Sir Isaac Newton said :—Like children playing with pebbles on the sea shore, whilst the great ocean of truth lies unexplored in front of us.

THE YORK RAINFALL.

By J. EDMUND CLARK.

ANOTHER ten years has elapsed since this subject was discussed in my paper on "Fifty Years of York Meteorology. That was based on the Annual Reports in our Proceedings and, to some extent, on occasional references to previous observations.

In this way were obtained the following means for 1841-90:

We can now add:—

	Year.	Jan.	Feb.	Mch.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Fall	25·005	1·74	1·52	1·67	1·61	1·81	2·24	2·66	2·68	2·40	2·62	2·09	1·96
Days	170·6	14·5	13·1	14·1	13·4	13·4	12·6	13·3	14·1	13·7	17·0	16·6	15·1

We can now add:—

Fall.	Year.	Jan.	Feb.	Mch.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1811-1824 + 3·3 %	24·54	1·70	1·55	1·53	1·67	2·26	1·96	2·75	2·26	1·94	2·91	1·92	2·08
1831-1840 ..	24·014	1·717	1·706	1·711	1·551	1·468	2·385	2·577	2·456	2·114	1·981	2·591	1·727
1891-1900 ..	24·326	1·690	1·586	1·320	1·551	1·830	2·348	2·188	2·885	1·649	3·028	2·017	2·204
70 yrs. 1831-00	24·766	1·732	1·554	1·624	1·591	1·765	2·277	2·583	2·681	2·258	2·585	2·154	1·962
Dif. from 50 yr.	—·239	—·011	+·037	—·043	—·016	—·046	+·035	—·080	—·004	—·145	—·033	+·066	+·001
84 yrs. 1831-00 + 1811-24	24·728	1·725	1·552	1·608	1·605	1·848	2·225	2·611	2·611	2·206	2·640	2·116	1·981
Dif. from 50 yr. 1840-90	—·277	—·018	+·035	+·059	—·002	+·037	—·017	—·052	—·074	—·197	+·022	+·028	+·020
Days.													
1891-1900 ..	187·2	18·2	14·4	16·4	13·9	13·9	13·0	13·0	17·1	14·1	18·7	17·6	17·9
60 yrs. 1841-00	173·4	15·1	13·3	14·5	13·5	13 2	12·8	13·3	14·6	13·8	17·3	16·8	15·6
Dif. from 50 yr.	+ 2·8	+ 0·6	+ 0·2	+0·4	+ 0·1	+0.1	+ 0·2	0·0	+ 0 5	+ 0·1	+ 0·3	+ 0·2	+ 0·5
30-Day Months.													
70 years, 1831-1900 ..	1·677	*1·650	1·571	1·591	1·708	2·277	2·500	2·594	2·258	2·502	2·154	1·899	
Dif. from 50 years ..	-0·010	+·038	—·042	—·016	—·015	+·035	—·077	—·004	—·145	—·032	+·066	·001	
84 years { 1811-24 / 1831-90 }	1·667	1·637	1·556	1·605	1·788	2·225	2·527	2·527	2·206	2·555	2·116	1·917	
Dif. from 1841-90 ..	- ·020	+·025	—·057	—·002	+·035	—·017	—·050	—·071	—·197	+·021	+·028	+·019	

*Allowing for 21 Leap-years.

Fortunately the lost records, left to our Library by the late John Ford, from 1831 to 1870, have been discovered, except for the year 1831 itself. The rainfall values for this year were however supplied by him to the late G. J. Symons, and are thus preserved for us.

The 1811-24 values are from the monthly means for those years, presumably by Mr. Jonathan Gray, used by Professor Phillips in his "Rivers, Valleys, and Seacoasts of Yorkshire." These records were begun in 1801. The discovery of them would be of great interest and value. His gauge appears to have been placed 3 feet above the ground. The values given by Phillips have therefore been increased by 3·3, on grounds which have most recently been stated in the 1900 volume of "British Rainfall," by Mr. Hugh R. Mill.

In the two decades, now added, the driest years were 1834 (18·49 ins.) and 1896 (21·98 ins.) The wettest were 1839 (26·43 ins.) and 1894 (28·08 ins.) The last decade, with an average fall of 24·326 ins. was 0·675 under the mean for the previous 50 years. But the "wet days" exceeded the same mean by no less than 16½ days, being nearly the same as the mean for the seventies and slightly less than the eighties.

The values for each decade are shown in the accompanying tables:

MEAN RAINFALL IN DECADES, 1831—1900.

	Decade.	Yearly.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	Decade.
I.	1831-40	24·014	1·72	1·71	1·71	1·55	1·47	2·39	2·58	2·46	2·14	1·98	2·59	1·73	I.
II.	1841-50	24·835	1·67	1·50	1·53	1·74	1·84	2·52	2·86	2·75	1·91	2·91	2·04	1·63	II.
III.	1851-60	23·265	1·78	1·16	1·36	1·41	1·66	2·51	2·65	3·08	2·27	2·07	1·77	1·55	III.
IV.	1861-70	23·937	1·70	1·52	1·77	1·41	1·79	1·95	1·63	2·57	2·53	2·74	1·90	2·44	IV.
V.	1871-80	28·036	1·77	1·78	1·75	1·86	1·79	2·51	3·04	2·53	3·36	2·71	2·68	2·27	V.
VI.	1881-90	24·952	1·87	1·62	1·92	1·62	1·98	1·71	3·13	2·50	1·95	2·66	2·06	1·92	VI.
VII.	1891-00	24·326	1·69	1·59	1·32	1·55	1·83	2·35	2·19	2·89	1·65	3·03	2·05	2·20	VII.
Range ...		4·771	0·26	0·62	0·60	0·45	0·51	0·81	1·50	0·61	1·71	1·05	0·91	0·89	Range
Wettest Decade		V.	VI.	V.	VI.	V.	VI.	II.	VI.	III.	V.	VII.	V.	IV.	Wettest
Driest Decade		III.	I	III.	VII.	IV.	I.	VI.	IV.	I.	VII.	III.	III.	III.	Driest
70 Years ...		24·766	1·73	1·55	1·62	1·59	1·77	2·28	2·58	2·68	2·26	2·58	2·15	1·96	70 years
		Yearly.	Jan.	Feb.	Mch	Apl.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov	Dec.	

MEAN DAYS WITH RAIN, SNOW, &c., IN DECADES, 1841*—1900.

	Decade.	Yearly.	Jan.	Feb.	Mch	Apl.	May	Jun.	Jul.	Aug.	Sept	Oct.	Nov	Dec.	Decade.
II.	1841-50	159·8	13·1	9·8	13·7	14·3	14·2	12·2	13·3	13·8	10·4	17·6	14·4	12·5	II.
III.	1851-60	147·3	12·6	10·0	9·5	10·4	11·8	13·9	11·0	12·5	12·2	15·7	15·0	12·8	III.
IV.	1861-70	168·0	14·7	13·9	15·8	12·3	11·6	11·2	10·5	13·4	15 3	16·7	16·3	16·3	IV.
V.	1871-80	187·9	15·1	16·4	16·5	14·6	13·9	14·4	15·5	15·3	15·1	16·5	18·1	16·7	V.
VI.	1881-90	190·0	16·8	15·1	15·1	15·5	14·0	11·2	16·3	15·3	15·7	18·5	19·4	17·4	VI.
VII.	1891-00	187·2	18·2	14·4	16·4	13·9	13·9	13·0	13·0	17·1	14·1	18·7	17·6	17·9	VII.
Range ...		42·7	5·6	6·6	7·0	5·1	2·6	3·2	5·8	4·6	5·3	3·0	5·0	5·4	Range
Most Days		VI.	VII.	V.	V.	VI.	II.	V.	VI.	VII.	IV.	VII.	VI.	VII	Wettest
Least Days		III.	III.	II.	III.	III.	IV.	{IV. VI.	IV.	III.	II.	II.	II.	II.	Driest
60 Years ...		173·4	15·1	13·3	14·5	13 5	13·2	12 8	13·3	14·6	13 8	17·3	16·8	15·6	60 years
		Yearly.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII	

* The Returns previous to 1841 are incomplete.

It will be noted that the 70 years mean of 24·766 ins. is nearly $\frac{1}{4}$ in. less than that for 50 years (25·005). This result justifies the suggestion made on p. 54 of the 1891 Report, that the 50 year average was greater than the true value in consequence of the abnormal fall in the seventies.

Assuming that for 70 years the limit of error is $\frac{1}{7}$ the variation of the seven decades from the mean, we may now consider that the mean rainfall for York is 24·766 + 0·341 ins. and *still* regard this value as above rather than below the true mean. This may be based on the two following facts:—

Adding to the above the (corrected) values for 1811-24, we find a mean of 24·728 inches for the period of 84 years.

Omitting the seventies decade, the mean for the other 60 years, 1831—1900 is 24·222 inches.

We may therefore conclude pretty safely that the true mean for York does not differ much from $24\frac{1}{2}$ inches.

The days with rain were not fully recorded in the thirties. The indication is that the mean was about 150. For the last decade the mean is 187·2, which brings up the mean for 60 years to 173·4. The first three decades are all *less*, the last three *more* than the mean. Does this indicate a more stringent registration, since 1870, of each day's rainfall, or is it confirmed by records elsewhere?

This suspicion of possible error fortunately does not affect the very interesting question of relative monthly rainfall. Here we find, for the 70 years, that March comes out decidedly the month of least rain. There is also an accentuation of August as wetter than July and October, and of September as much less wet than these three. The 84 years accentuates more strongly the characters of March and September.

On the other hand the addition of the 1811-24 observations actually deposes July and August in favour of October as the wettest month, and equalise these two. I wish to insist strongly upon the significance of this. A hundred years will perhaps give the annual rainfall within 1%, but probably 200 years or more would be required to be sure of the monthly rainfall within, say 3%. For, while the 50 year annual fall is within about 1% of that for 84 years, the September fall differs by nearly 10% . This, it is true, is largely the result of the abnormal excess in the seventies decade (33½ inches against an average of 21¼ in the five other decades), but this simply illustrates the possibilities of erratic monthly falls over a period of many years. The difference in March, which comes second in divergence is 3%. Only in April is it inappreciable.

How entirely inadequate a ten-year period proves to be is further illustrated by the following table* :—

Decade ending.	*Driest month.*		*10 yrs. fall.*	*Wettest month.*		*10 yrs. fall.*
1840.	May	...	14·68	November	...	25·91
1850.	March	...	15·30	October	...	29·11
1860.	February	...	11·64	August	...	30·82
1870.	April	...	14·11	October	...	27·42
1880.	March	...	17·51†	September	...	33·55§
1890.	April	...	16·15	July ...	...	31·34
1900.	March	...	13·20	October	...	30·28
(1811-24)‡	March	...	15·29	October	...	29·14
	Four months—Feb. to May).			(Five months—July to Nov.)		

* These are the *absolute* falls, but the month, with one exception, would in every case be the same if reduced to a 30-day mean. § Only 16·49, or *less than half*, in 1891—1900. † January was only 0·15 more. ‡ Taken reduced to 10 years and 3·3% added as correction for height of gauge above ground.

One result of these further records is to alter the view based on the 50 years averages that probably August was the wettest month. It now certainly seems that October has the stronger claim.

The evidence is now stronger that August is wetter than October at times of sun-spot minima and *vice versa*. The 50 years (1841-90) gave therefore an undue advantage to August, as it included 5 minima, but only 4 maxima.

There have been five changes, in all, in the greatest and least monthly rainfall in any year. The maximum now is 3·75 for Jan. (1834), and 4·86 for Nov. (1836). The minimum is now 0·08 for Feb. (1891), 0·22 for May (1836), and 0·20 instead of 0·72 for Oct. (1834). The 0·08 for Feb. (1901) is the least of any month in the 70 years. As a fact *no* rain fell actually in February. Part of the above was due to fog and the rest to rain after midnight on the last night, which therefore fell on March 1st, though technically counting to Feb. 28th.

There were no monthly falls over 5 inches to add to the 11 in the previous record, either in the thirties or nineties.

Appended are two graphic representations. Plate I. gives the monthly rainfall curve for 1831—1900 and days with rain. The latter and the dotted rainfall curve give the values corrected to 30 days for each month. In both these the curve is very regular, save for the curious drop in September. A comparison of the rainfall curve and that of the number of wet days shows strikingly how much the totals in July and August depend upon a few heavy falls. In the second plate curves of absolute rainfall means are given to compare the three periods of 50, 70, and 84 years.

The broad results are that York Rainfall averages $24\frac{1}{2}$ to $24\frac{3}{4}$ ins., of which $10\frac{1}{4}$ ins. fall in 6 dry months—December to May, the average per month being $1\frac{1}{2}$ to $1\frac{9}{10}$ ins. The other 6 months all exceed 2 ins., although their total is only $4\frac{1}{2}$ ins. more. March has least rain, October most, but the heavy falls in July and August nearly make up for the larger average of wet days in October. June has the fewest rainy days and November the most. The range, however, is only from about $12\frac{1}{2}$ to $16\frac{1}{2}$ days.

NOTES ON EXCAVATIONS AT 25, 26, AND 27, HIGH OUSEGATE, YORK.

By GEORGE BENSON, A.R.I.B.A.

THESE excavations were commenced in September, 1902, and completed by the end of January, 1903. The area has a frontage of 46 feet to High Ousegate and stretches to Coppergate, a distance of ninety-four feet. Nearly the whole area has been dug out from kerb level at Mr. Pickering's, in High Ousegate, for a depth of 10 feet 6 inches. The material was a black warp deposit, matted with brushwood, pieces of leather, bones and horns of cattle, sheep, pigs, goats, etc., tusks of boars, cut antlers of red and fallow deer, and occasionally oyster shells. A thin light-coloured strawy band, two inches deep, occurred here and there, and gave out a strong odour that savoured of manure. The deposit was very compact and could be cut vertically, and on digging into it vapours were emitted similar to steam. Amidst this subsoil were a number of horizontal timber balks, about 9″ × 9″ rebated, and a quantity of piling, the positions of which were noted and a plan and sections made (Figs. 1, 2, 3, 4, 5), these indicate that the area was the site of tanpits.

The pit towards High Ousegate rested on a twelve-inch bed of puddled clay, the centre pit had a nine-inch bed of yellow sand, whilst the one at Coppergate end had, at the bottom, a lime deposit five inches in thickness.

Towards Coppergate was a wickerwork stockade, formed by a double row of birch posts, one row upright, the other sloping towards it on the eastern side, at the base the posts were six inches apart. The posts were three inches in diameter and

spaced some four inches apart, zigzag on plan, between which were plaited, in and out, hazel boughs, one inch in diameter, each laid closely and alternately, and standing in some parts 8 feet high; the greater part had been cut down in making foundations, leaving an average height of 5 feet. The stockade was exposed for a length of 32 feet, the Coppergate end was not reached, and it seems towards High Ousegate it had been cut away for the formation of the pits. Under Coppergate were remains of trees, in position, and about 9 inches in diameter.

Large blocks of masonry occur at N (Fig. 2.), forming one side of a doorway (Fig. 1). Similar stone was removed from a large abutment shown at M (Fig. 2). The masonry seemed to be Roman work, and was sandstone grit with one exception of magnesian limestone. The bases I J (Plate IV.) are Roman, and the caps G and H may also be so.

A cobble road (Fig. 1) about five feet below present one, extended under the gabled houses from and parallel to High Ousegate for a width of six feet; beneath were paved passages shown on plan. The passages sloped towards Coppergate. A portion of a rectangular drain, formed of timber 3″ thick and 18″ high and 14 inches wide was taken up.

The site of the excavations has been subject to floods, warp being deposited, and vegetation growing between times to be entombed by warp with recurring floods. The district was a swampy one; the leg bones of a stork or heron were found. The area has been raised by warp deposits and in later times the road was heightened five feet, may be as a barrier between the two rivers when in flood. The depth of this warp deposit has not been reached, although penetrated three feet below present level of digging.

The Tannery has been erected on the then high ground, whilst for washing skins, pits were sunk in the warp; other portions of the area were used for refuse tips, which accounts for leather, bones and horns jumbled together, whilst the wickerwork stockade has been buried in such accumulations. When digging was general, as much as 20 stones of bones and horns were gathered in one day, 12 stones on other days, and with little digging two bags resulted for the day's work.

Antlers were numerous, also tips of same; some were ornamented, whilst one was carved into an animal's head. Large needles of bone were plentiful and may have been used for skins; some needles had shaped heads and similar objects unpierced, may have acted as pins. A couple of squared bones $\frac{1}{2}$ inch wide and $4\frac{3}{4}$ inches long, had one side ornamented with lines, the upper part of one had a human head indicated by curved lines. Several horn combs, with backs and ends shaped, had ornamental designs formed by lines. A few horn pocket knife hafts were found, also a razor-like haft with incised lines at end and in centre.

Amongst the whetstones for sharpening tools were a few pocket ones, with ends pierced; one had a lead end also pierced. Several knives, mostly with long spikes for inserting into handles, were discovered; one possessed a wood handle; these were probably used for scraping skins. One pocket knife had an iron haft and fixed pricker at one end. A portion of a wood comb, five inches wide, had rough teeth on one edge and fine on the other.

Other objects unearthed were early hammered iron door keys, a few wood bowls (one 18 inches in diameter), a polished stone axe, spindle wheels, a couple of bone skates with line ornament, jet ring, pendant of amber $1\frac{1}{2}$ inches long pierced, a small terra cotta head with sphinx like covering, size 1 inch by three-quarter inch, a blue stone setting for a brooch, a few legs of game-cocks with natural spurs, old pipe marked P.C., and stones 3 inches in diameter pierced for grindstones or weights, one was hollowed at both ends like a quern.

In leather, were shoes, some laced, others had leather laces twisted into knots which served as buttons, may be the origin of button boots, some had one others two; some pouches and dagger and sword sheaths were met with. Amongst pottery were fragments of Samian ware with hunting scenes; also green glazed and black pottery. In metal, a horse shoe $4\frac{1}{4}'' \times 3\frac{3}{4}''$ made out of $1'' \times \frac{1}{8}''$ metal with oblong countersunk holes for nails, and a small spur. Two barrow loads of thin copper about $6'' \times 1''$ were found at X on plan (Fig. 2); close by were remains of two furnaces.

In Plate III. (Fig. 2), the etched portion indicates the position of demolished buildings. The two-gabled house in High Ousegate was dated 1635, the carved barge-boards, etc., have been re-used on a building in Marygate. The joists and timber which formed the ceiling on first floor had stencil patterns, 3 inches deep, painted between the joists; this ceiling was removed to, and re-used at, Huntington Hall. A piece of square panelling in oak, about 80 feet super, went south. During the demolition two brick arched fireplaces, back to back, were revealed; one 5 feet wide in long room; the other occupied an angle of a smaller room. Behind the gabled house was a garden, and from the discovery of a portion of a red stone balustrade (Plate IV. L) it would seem to have been a typical 17th Century garden, which was subsequently destroyed, and a three-storied house built in it. Facing Coppergate was a shop and house, erected some forty years ago, when it was set back for the building line of to-day; the shop was occupied by Mr. Ralph, printer. On this site, business premises for Mr. G. W. Harding are in course of erection, from the design of Messrs. Monkman and Hornsey. The writer is indebted to Mr. Thompson, who is in charge of the works, for affording him facilities for observation.

The house, 25, High Ousegate, had overhanging stories; the floor joists were formed of tree trunks, seven and eight inches in diameter, laid sixteen inches apart. The house is being rebuilt as an addition to the business premises of Mr. C. M. Brown.

In the Ethnological Room in the Museum is a glazed case containing a large number of objects classed as Danish and which were found during the formation of Clifford Street. These objects are like those found in High Ousegate, and similar deposits of warp, bone, horn and leather have been removed under Mr. Dyson's premises in Coppergate, under Barclays' Bank, also in Parliament Street, Pavement, and Silver Street, so that the tan-pits unearthed in High Ousegate may be only a small portion of an ancient extensive tannery.

NOTES ON CLIFFORD'S TOWER.

By GEO. BENSON and H. M. PLATNAUER.

MEMBERS of this Society, and all others who are interested in the preservation of historical relics, owe a debt of gratitude to Lord Wenlock and other members of the Yorkshire County Committee, who, acting under the advice of Mr. Micklethwaite, induced His Majesty's Government to make a grant for preserving Clifford's Tower before restoring it to the custody of the County of York. The nature of the operations undertaken for this purpose commands our admiration no less than does their object, for the work is thoroughly and effectually done, and it is *concealed*, thus achieving its purpose without in any way offending the eye.

The writers of these notes do not propose to deal with either the history or structure of Clifford's Tower. The former is excellently summarized in a brochure written by the Castellan, Mr. F. J. Munby, and entitled "Clifford's Tower, a prospect and retrospect." For information as to the structure of the keep, the reader is referred to an able paper by Mr. G. T. Clark in the Proceedings of the Yorkshire Archæological Society for 1874, while fuller and more general information as to its purpose may be obtained by reference to the same writer's work on "Mediæval Military Architecture." Those who desire to have a more critical knowledge of the subject would do well to read a criticism of Mr. Clark's views by Mr. J. H. Round in "Archæologia" LVIII., pt. 1, pp. 313-340, and also a paper by Mrs. Armitage in Proc. Scot. Soc. Ant. XXXIV., pp.

260-288. It is simply proposed to record here—(1) the general conclusions arrived at as the result of observation made during the progress of the work, (2) the nature of the work undertaken, (3) a few details respecting observations made and objects discovered.

(1) GENERAL CONCLUSIONS. These may be very briefly stated. The mound is an *artificial* one : cuttings made in the sides at a distance of 25ft. from the boundary wall towards the centre failed to shew any natural core. A trench 15ft. 6in. deep was sunk within the keep, and a boring was made 10ft. 6in. from the bottom of this trench. Both trench and boring, which together went down to within 10ft. of the ground level, revealed nothing but loose made soil. At a depth of 13ft. in this trench and again at 15ft. 6in. were found remains of timber work that point to the existence of a wooden fortification preceding the existing shell keep and built on a smaller mound. This mound has been increased to its present dimensions with great care and with enormous labour. In order to give the newer mound stability, an outer crust of firmer and more clayey material has been made round the older summit, and lighter material has been placed inside this crater to bring it up to the necessary level. The occurrence of a considerable quantity of charred wood above the lower series of timber remains, indicates that the wooden fortifications have suffered from fire. It would scarcely be rash to assume that it was the first castle of the Conqueror, burnt in the revolt of 1069. The existence of a second layer of timber work seems to shew that the fortification thus destroyed was rebuilt in wood. This is quite consistent with the assertion that the second castle was completed in eight days.

The objects found in the course of excavation help very little chronologically, for they were scattered confusedly, and most were found in the lateral cuttings. Roman pottery was found in fairly considerable quantity. But this does not necessarily prove that the mound was used by the Romans. The pottery may have been in the soil excavated, and brought up by the Norman builders to enlarge the mound. That a mound existed in Celtic times is very probable; the oldest known name of the city *Aberach* or *Evrach*, " the mound of the

estuary" or "the mound of the Eure," seems to point to it.* But this mound was most likely a small one, and would only have been cut into to a slight extent by the recent excavations. A burial of very primitive type was indeed discovered, the skeleton of a body that had been buried in a crouching position, surrounded by four pieces of rough sandstone and covered by another somewhat larger stone. The writers cannot lay much stress on this piece of evidence, as the grave was broken up before they had had an opportunity of inspecting it: the account just given is from hear-say. There is nothing that conclusively proves the existence of a Celtic mound, though—as already indicated—negative evidence does not in this case constitute disproof.

The conclusions to which the writers have arrived are meagre, and may even seem disappointing. It must however be remembered that the excavations made were undertaken for engineering purposes, and not for investigation. But the results incidentally obtained are sufficiently interesting to make a systematic exploration of the mound very desirable.

(2) Nature and Object of the Work. The difficulty to be met was the gradual sinking of the gateway and adjoining parts towards the south-east. This may have been caused, and certainly must have been at least accelerated, by the curtailment of the mound about 1836. At this time a nearly circular retaining wall, of massive structure, was built and furnished with internal buttresses, to hold up the mound. The weight gradually thrust the upper stones of this wall outwards. The danger might have been considerably less had the keep been whole, but the disastrous fire and explosion of 1684 had seriously rent the walls; and the fore part of the keep, no longer bonded to the rest of the building, sank forward as the mound gave way beneath it. Iron ties were used within, and a large wooden raking shore was recently erected, but in spite of all this, the settlement continued. Things were in this condition when the Committee

*The word *ach* at the end of *Evrach* may, however, be the Gælic *auch*, a field. We might here mention, with reference to the view expressed by some that the course of the Foss was altered in Norman times, that in 1835 two Roman coffins were discovered in the green that forms the centre of the Castle yard.

entrusted to Mr. Basil Mott the task of securing the mound and keep against further subsidence. Mr. Mott took effectual steps to achieve this. He had the whole of front part of the keep underpinned with concrete to a depth of 6ft. and to 3ft. on each side of the foundation (making a total breadth of 17ft. of concrete), the looser parts of the foundation were grouted in to keep this mass of concrete in place, five huge ribs 6ft. broad and going down to the clay beneath, were cut into the sides of the mound and filled in with concrete. By these means, the arc of concrete holding up the wall is supported by five flying buttresses of solid concrete resting on the underlying boulder clay and covered by the turf of the mound.* It was found that the sinking of the mound was due in part to the loosening of the soil by tree roots, and in great measure to the accumulation of water in the loose stonework within the mound. The interior of the mound has been drained, and a channel has been made to carry away the water.

The nature of this work can, however, be best gathered by reference to the accompanying plans kindly furnished to us by Mr. Mott. An explanation of the plans is appended.

(3) General Observations and Notes on Objects Found. The rock on which the mound is erected is a solid, reddish clay, overlaid by a bed of lacustrine marl of very variable thickness, apparently deposited by a tidal river in pools. In this marl was discovered a wooden boatstay, evidently of great age, with an iron nail sticking into it. There was no regular order of succession in the various kinds of soil excavated in the sides of the mound. Two trenches were cut in the interior of the keep, in order to trace the origin of some water that escaped into the workings. In these were found 11ft. 6in. of reddish gravel followed by 2ft. of black clay, then the remains of a 6in. platform of oak, 2ft. 6in. of black clayey soil followed, and remains of a similar oak platform were found supported by posts. A boring taken down 14ft. further shewed the same black soil. At 3ft. from the base of the retaining wall and 23ft. from its parapet (that is, 4ft. 6in. below the present level) were found the bones to which reference was made before. They rested on the clay, and apparently represented a cist

* See Plates VI. and VII.

interment of a rough and primitive character. The walls of the keep go down to a depth of 6ft., and the foundations, 11ft. wide, rest on a bed of firm puddled clay 1ft. deep.

A large number of bones was found in every part of the mound. Human bones were abundant, especially in the interior of the keep. Several skulls were discovered, one close to a pointed stake, but all were more or less imperfect. Many of the limb bones were of large size: one femur measured 21 inches (20in. from the top of the neck below the great trochanter to the fossa between the condyles). Bones of ox, sheep, and pig were abundant, those of horse, dog, and domestic fowl occurred more rarely. Many pieces of deer antler were found, they had been sawn off preparatory to manufacture into combs, skewers, buttons, &c. A few boar tusks also occurred.

Many pieces of carved magnesian limestone were found in the interior. Amongst them were—a moulded corbel, a splayed and beaded piece of parapet, an arch stone with shallow hollow on splay and stop stone to same, an angle of moulded arch with dog-tooth ornament having a five-pointed one in angle, a small piece with ribbed laurel leaves forming two dog teeth beautifully sculptured, and a defaced springer above cap to arcade with dog-tooth ornament similar to that in the chapel above the entrance.

Various worked articles in bone and horn were found; a spindle whorl, some discs 1½in. across and ¼in. thick and marked with concentric circles (? for merrils or draughts), combs, and a roughly made ring.

Roman pottery, especially Samian ware, was tolerably abundant, but there was very little mediæval pottery. The bowls of several tobacco pipes were found, of Stuart type, and one bore the stamp of a fleur-de-lis and the letters N.H.; another had the initials T.B. Of leather only a few pieces were found, evidently portions of shoes.

A number of iron spikes and nails were taken from the timber work alluded to before, an iron cannon ball weighing 17lbs. was found, an arrow head and head of crossbow bolt, iron ring much rusted, a small knife blade, an axe head, a scythe cut down to form a bill or hedger, and two pieces of

iron too fragmentary and too much rusted to allow of determination. Of other metal objects, there were—a small brass ring, a small brass brooch or fibula (imperfect), a brass ornament (probably from horse trappings), one or two fragments of brass objects, and a leaden ring.

Very few coins were discovered. A small defaced silver Roman coin, a small copper coin of Constantine's, a well preserved styca determined by Mr. Heywood to be one of Ædilred (Cœnred, moneyer), and a halfpenny of George III. completes the list, unless we can include under this head some leaden imitations of pennies of William the Conqueror, the purpose of which is unknown.

Of miscellaneous objects, we may mention—a jet button; a piece of slate 3in. long, square in section and tapering to a point, the broad end perforated (? to be used for writing); a small piece of ground glass, a fragment of gold lace, and a dermal scute from the skin of a shark.

Two pieces of broken flint were found, but whether artificially chipped or fractured by natural means could not be determined. One quadrate piece of flint was encountered, which has apparently been prepared for making gun flints.

Remains of timber work were discovered at four points; at the junction of the fore court with the keep on the west side,* and in three short parallel trenches sunk within the keep. From exposures in these, it would seem that a line of timber work, probably forming part of a platform, ran S.W. and N.E. At the first point, the timber was found at a depth of 8ft. 6in., and consisted of oak slabs, some 5in. thick; others 9in. by $1\frac{3}{4}$in. in section. In the trenches, timber planks resting on forked uprights and piles were found. These forked uprights were roughly dressed tree-trunks over 8ft. in length, one was 7in., the other 9in. in diameter. In the trenches nearest the gate remains of a second line of timber work were found apparently running at right angles to the first, but 2ft. 6in. below it. The excavation did not go deep enough to allow of a full exploration of this second level of timber work. It had a timber bottom, which was sawn through at one point, and against it was piled a line of large loose stones, over 10ft.

* Plate VI., C.

in breadth and to a height of 6ft. This may have been put to support the woodwork, and to render it difficult of approach. But as to the real nature of the woodwork, we have no certain evidence. It may even have been a drain. The trench last dealt with also shewed traces of a line of timber work parallel to the first (S.W. and N.E.) line, and at the same level.

Most of the objects found, and specimens of the timber alluded to above, are preserved either at the Castle or in the Museum of the Yorkshire Philosophical Society. A few of the human bones have been preserved in the latter building. The rest have been carefully re-interred under the direction of Mr. Talbot.

The writers wish, in conclusion, to express their thanks to Mr. F. J. Munby, the Castellan, Mr. Basil Mott, the Engineer, and Mr. George Talbot, under whose supervision the work was carried out. All these gentlemen gave every facility for the investigation of the work during its progress, and to Mr. Mott we are further indebted for the plates that illustrate this paper.

EXPLANATION OF PLATES VI. AND VII.

PLATE VI.—Plan of the Keep and Mound surrounded by its retaining wall. Ground level plan marked in full lines; plan of top in dotted lines. The over-hang of the front part of the Keep can thus be clearly traced. The concrete inserted during the recent operations is marked thus: — - — - — -

C.—The place where timber was first discovered.

E.—Gateway.

T.—Indicates the quarter in which the trenches were sunk.

PLATE VII.—Shews a section of the Keep and Mound from side to side of the retaining wall along the line A. B. on PLATE VI. The recently inserted concrete is stippled and marked AA.

REPORT ON EXCAVATIONS IN S. MARY'S ABBEY DURING 1902.

By W. H. BRIERLEY.

The Excavations in the Choir of S. Mary's Abbey Church have been pursued steadily during the first half of the year. A considerable part of the foundations of the south wall of the arcade of the choir has been exposed, and a small portion of the apse of the Norman nave has been uncovered. It is now clear that the old basilica ended in a large apse with six apsidal chapels—three on each side diminishing in size from the centre. This is a very unusual type in England, but is occasionally met with in France. The plan as revealed so far corresponds almost exactly with that of the Abbey Church of Saint Sever, in the south-west of France.

Two coffin lids have been discovered in the course of the exploration. One is a simple and massive stone, roof-shaped at the top, the upper end missing. On the part left was the word THOMAS. The other stone, unfortunately broken and very imperfect, is of a much more elaborate character. It is a thick slab of limestone, the upper surface smooth, bearing incised upon it the figure of a bishop (or mitred abbot) in eucharistic vestments. On his head he wears a mitre, and carries a pastoral staff in the right hand and a book in the left. In the upper angles of the stone, above the shoulders, are two doctor's caps. In the margins on the side of the stone a somewhat imperfect inscription is cut. The portion on the sinister side is fairly complete; that on the dexter side is missing, with the exception of a few letters at the end. The

following letters are left; those in brackets are somewhat defaced, the rest are fairly clear.

(left side) . . . (m) seford sacre p gini' pfessor t quonda
Abba—hui' . . . u qui.
(right side) . . . . . u' aic ppic.

This inscription may be read as follows—

"William Seford sacræ paginis professor et quondam Abbas hujus Monasterii qui . . . . (cujus) animæ propicietur." (William Seford, professor of the Holy Book and formerly Abbot of this Monastery, who . . . . . to whose soul (God) be merciful).

This sepulchral slab, which was found a little south of the centre of the choir, is evidently that of William Seveyr, Sever or Seford, who became Abbot in 1485. In 1495 he was made Bishop of Carlisle, but continued to hold his Abbey in *commendam*. In 1502, he was translated to the see of Durham, and then resigned his abbacy. He died on May 14th, 1505, and was buried at S. Mary's Abbey. Bishop Seford is the Abbot who carried on a long and somewhat acrimonious controversy with the Corporation of York, at the end of the 15th century, on the subject of the rights and privileges of the Abbey, a constant subject of dispute.

The most important work of the year has been that undertaken to preserve the foundations already exposed. So fragmentary and so friable were these that one winter made considerable ravages, and the weather would soon have obliterated the results of our labours. It was therefore necessary to protect the remains from damage and decay, either by returning the excavations and re-turfing the surface, or by otherwise preserving them. The Committee appointed to carry out the work decided that to maintain them in a way that would leave them open for inspection would be the most popular and interesting. Various proposals were suggested and discussed, and the advice of Mr. St. John Hope, and others whose experience in such work is well known, was obtained. They unanimously recommended that the rubble foundations should be outlined and levelled up in ordinary brickwork, and coped with flagstones. This has been done,

blue bricks having been used for the 11th century work and red for that of later date.

The result has given rise to much comment and criticism on the part of many who do not clearly understand the real nature of the case, and the difficulties to be contended with. The excavations were not undertaken with the expectation of discovering picturesque ruins, but chiefly to ascertain as far as possible from such remains as lay below the surface the history and type of the different Churches that have occupied the site. The result is most instructive and interesting, and it is our duty to hand it on to future generations free from spurious imitations of old work or from additions which would, when weathered with age, only deceive and puzzle the observer. It has also to be borne in mind that in this instance we are dealing not with ruined walls, which tell their own tale, but with the ragged stumps and foundations of walls, underground work, constructed chiefly of rough material, and never intended to be seen, and which had to be interpreted if it was to interest or instruct the casual visitor.

(PLATE I.)

CURVES OF MONTHLY MEAN RAINFALL,

(ACTUAL AND REDUCED TO 30 DAYS MONTH),

AND OF

RAINY DAYS. YORK, 1831—1900.

Means of Monthly Rainfall & of Rainy Days, York, 1831-1900.

ACTUAL MEANS.

30 DAYS

(2·3 INCHES.)

(2·5 INCHES.)

MEAN FOR YEAR 24·766 INCHES

OR 2·064 PER MONTH.

(1·7 INCHES)

(16 DAYS)

MEAN DAYS FOR YEAR 173·4

OR 14·4 DAYS PER MONTH

(13 DAYS.)

(13 DAYS)

INCHES I II III IV V VI VII IX X XI XII INCHES

2·6 ·5 ·4 ·3 ·2 ·1 2·0 1·9 ·8 1·7 1·6

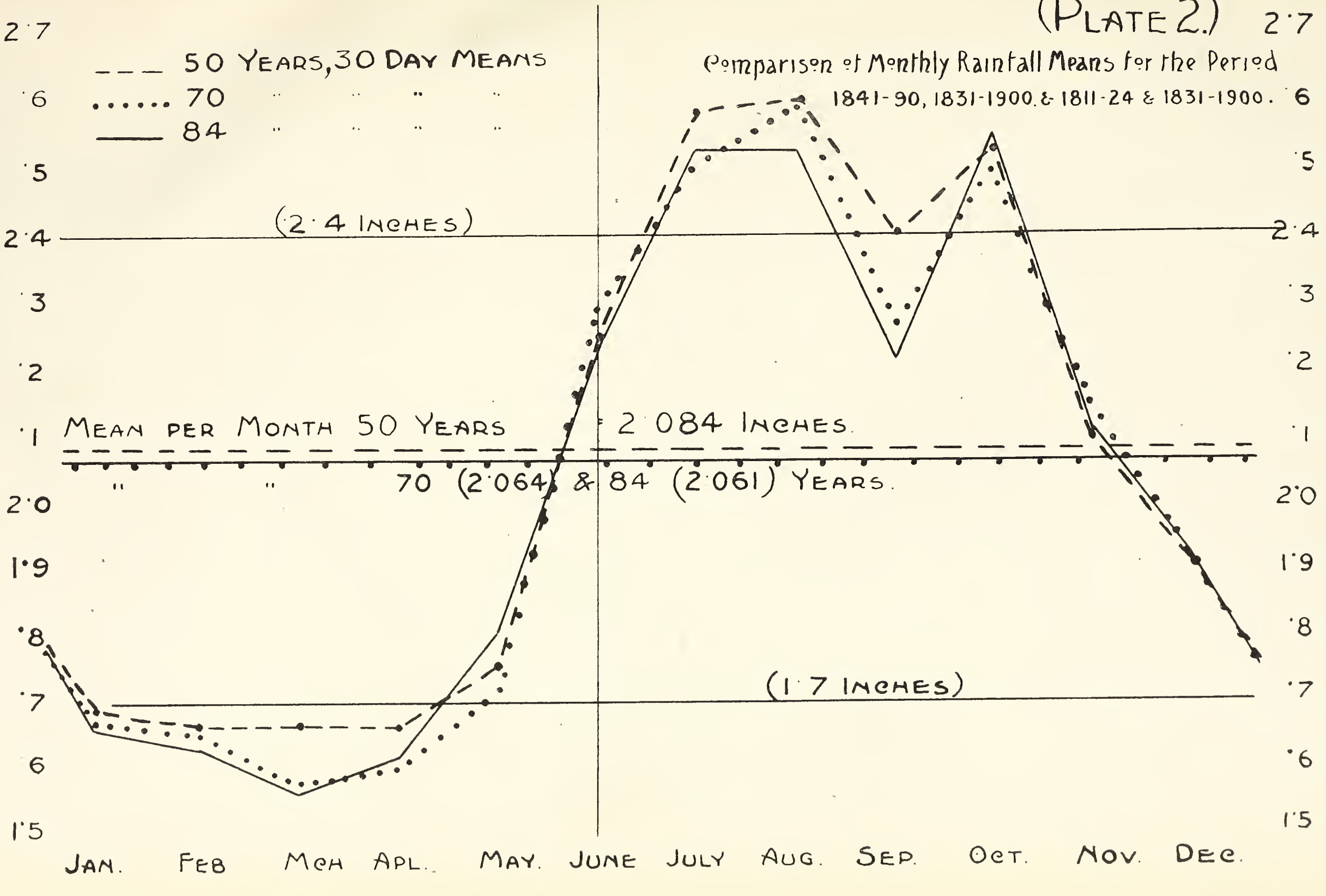
DAYS

1·5 1·4 1·3

JAN. FEB. MCH. APL. MAY. JUNE. JULY. AUG. SEPT. OCT NOV. DEC.

(PLATE 2.)

Comparison of Monthly Rainfall Means for the Period 1841-90, 1831-1900. & 1811-24 & 1831-1900.



MODIFICATION OF MONTHLY RAINFALL CURVE BY EXTENSION OF OBSERVATIONS FROM 50 TO 70 YEARS AND AGAIN TO 84 YEARS. YORK.


NATURAL HISTORY

25, 26 AND 27 HIGH OUSEGATE - YORK -

EXCAVATIONS 1902

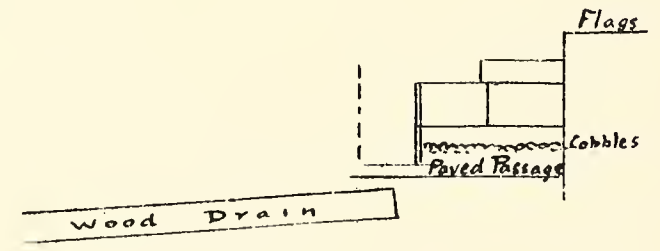
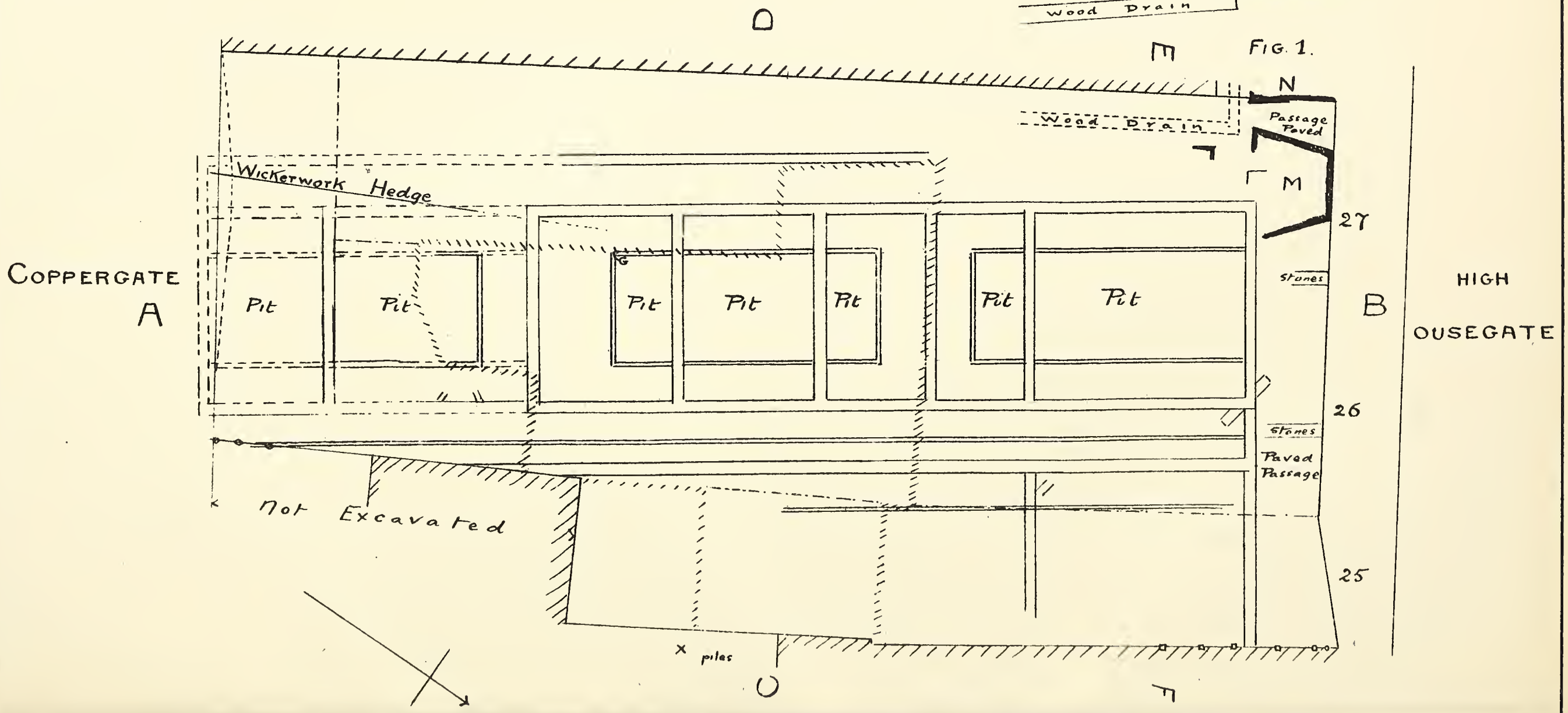
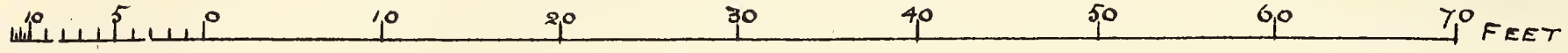


FIG. 1.



PLAN

PLAN



SCALE FOR PLAN AND SECTIONS

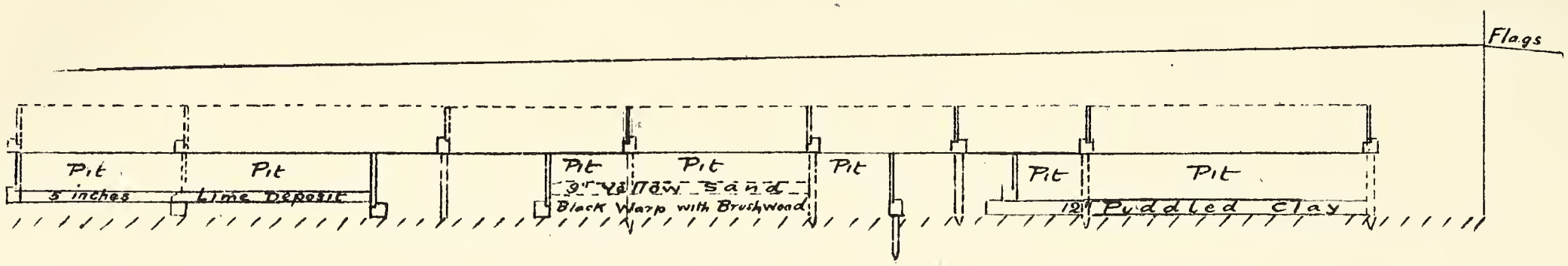


FIG. 3

SECTION AB

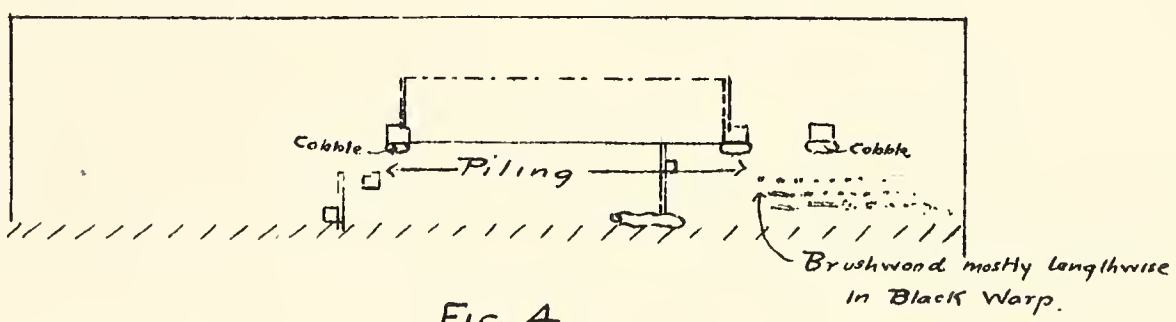


FIG. 4

SECTION CD

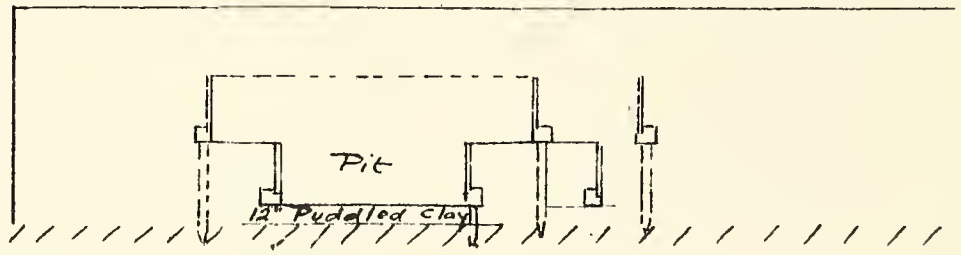


FIG. 5

SECTION EF

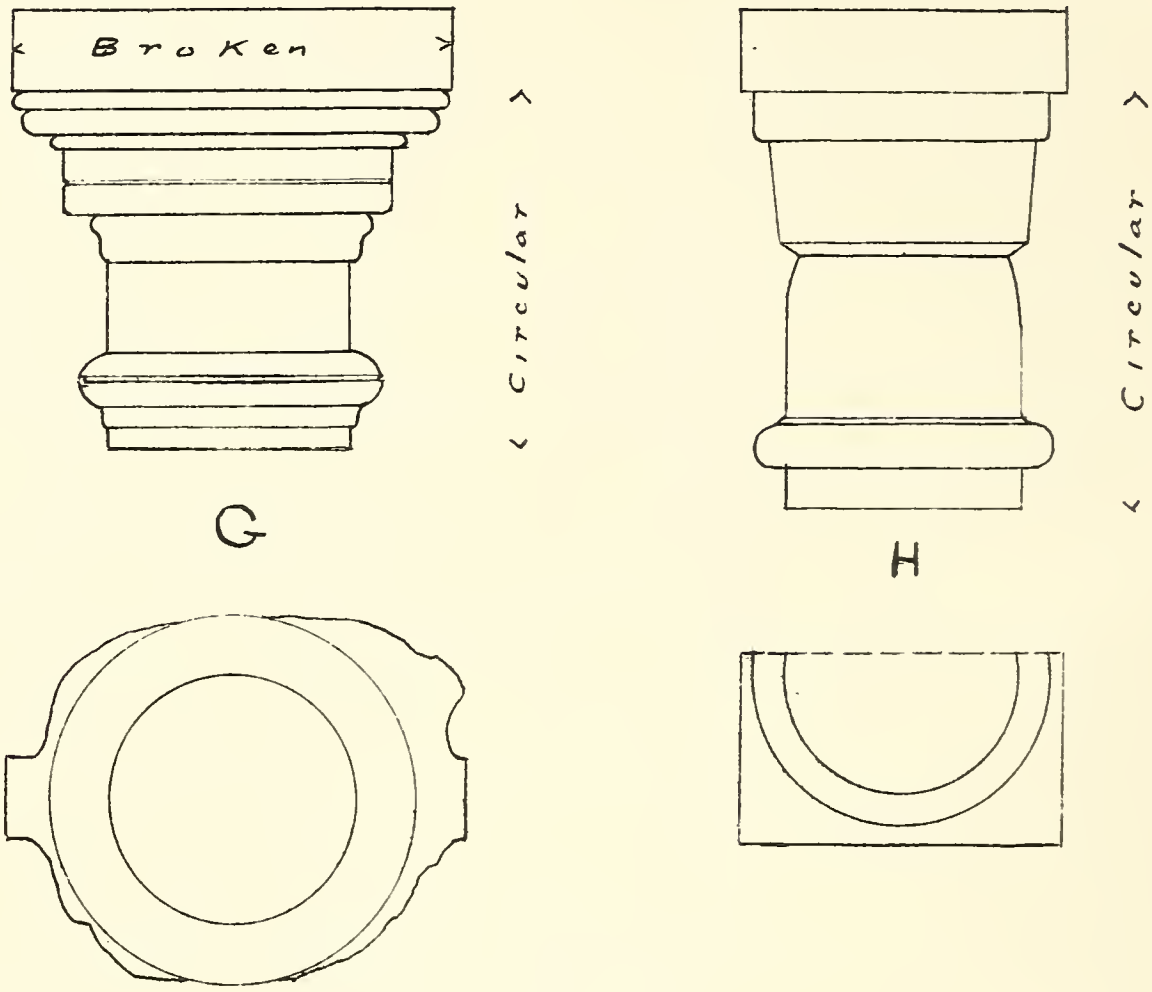
George Benson

Feb. 13. 1903

PHOTO-LITHO. SPRAGUE & Co LTD 4 & 5. EAST HARDING STREET, FETTER LANE. E.C.

25, 26 and 27 High Ousegate

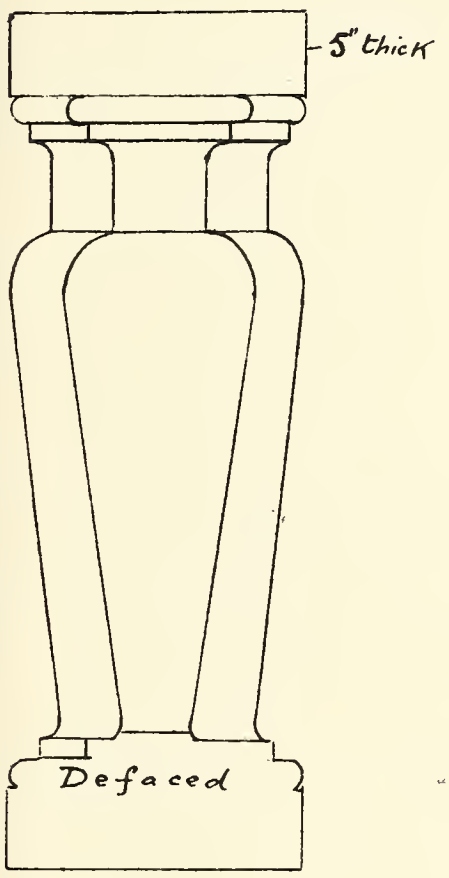
Excavations 1902

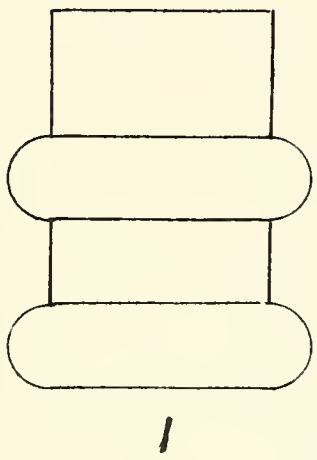


12 9 6 3 0
inches
SCALE FOR DETAI

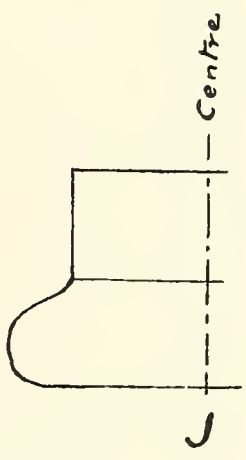
Feb. 13TH 1903

-YORK-

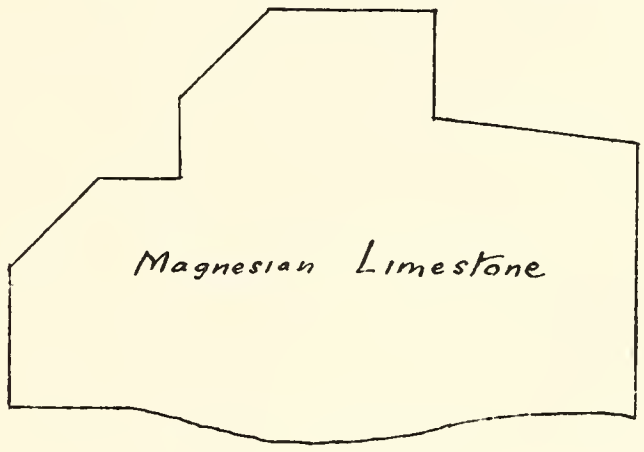




I



J



L

1' FOOT

DETAILS

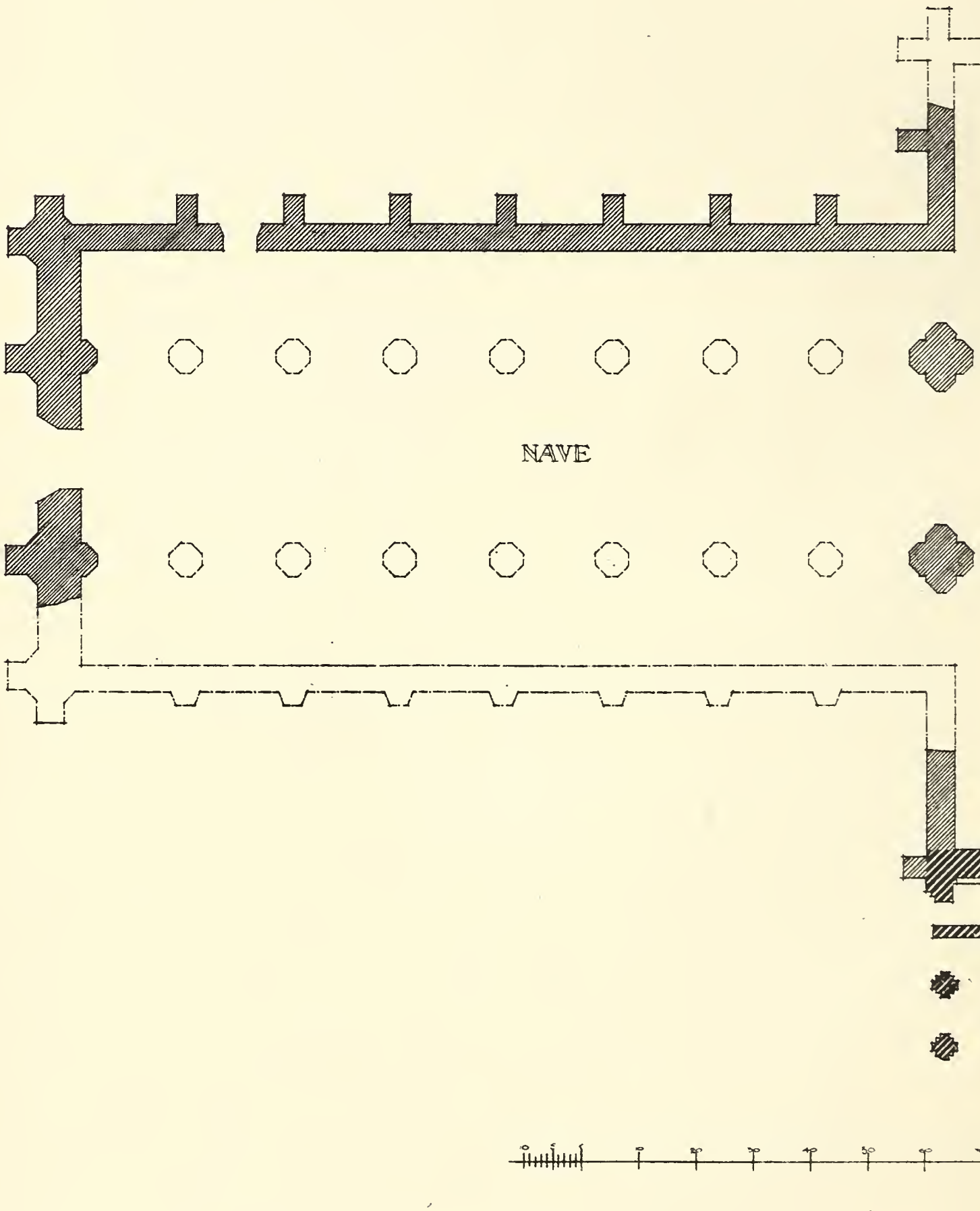
George Benson

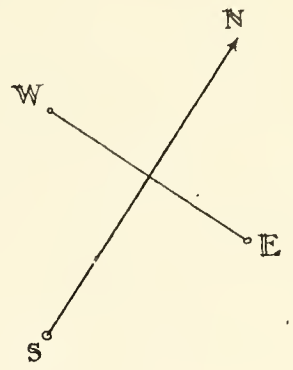
PHOTO-LITHO. SPRAGUE & Co LTD 4 & 5. EAST HARDING STREET, FETTER LANE, E.C.


NATURAL HISTORY

ST MARY'S ABBEY YORK.

■ SHEWS NORMAN 11TH CENTRY.
▨ " " EARLY ENGLISH 12TH " " ".
▨ " " GEOMETRICAL 13TH " " ".





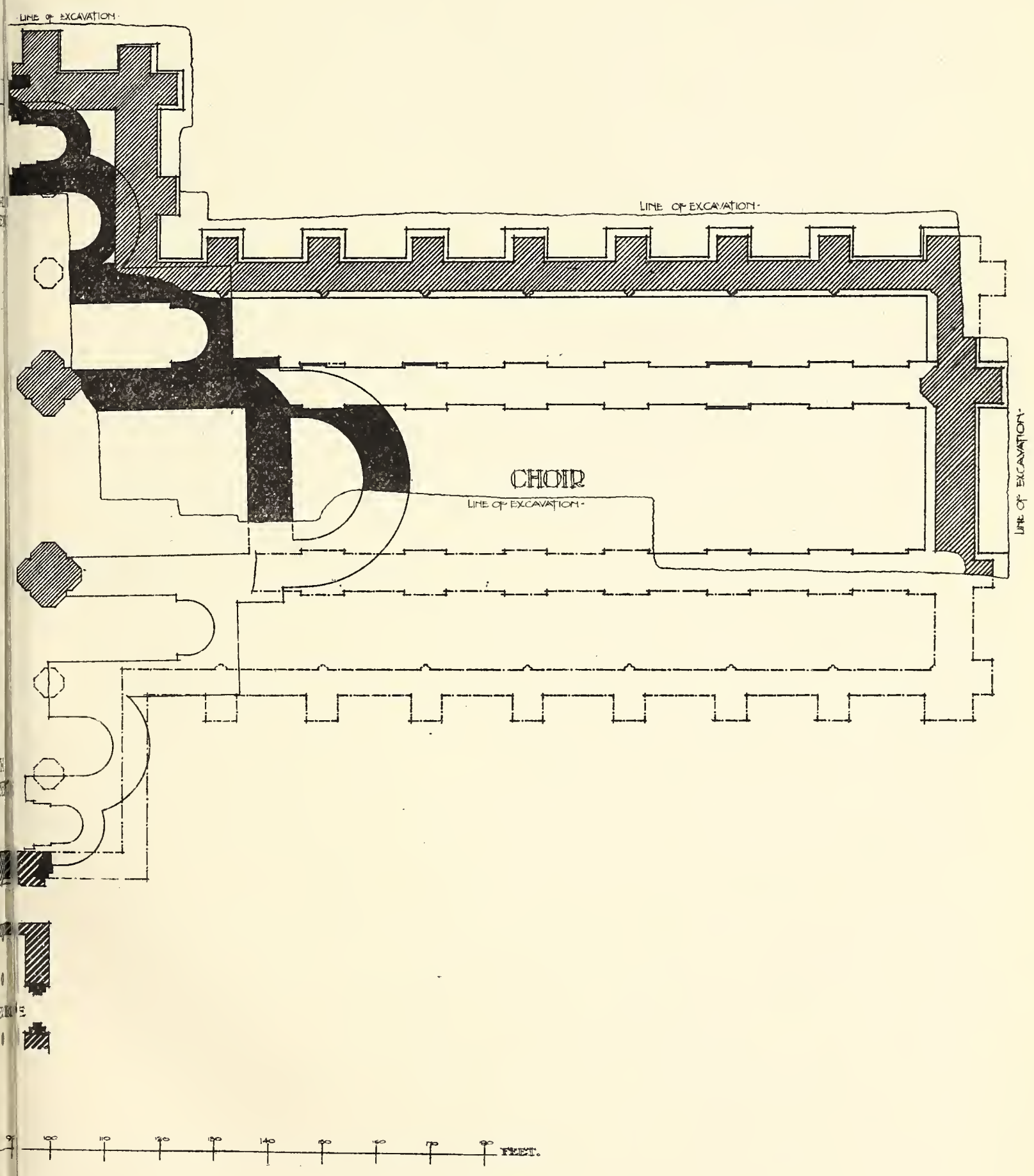
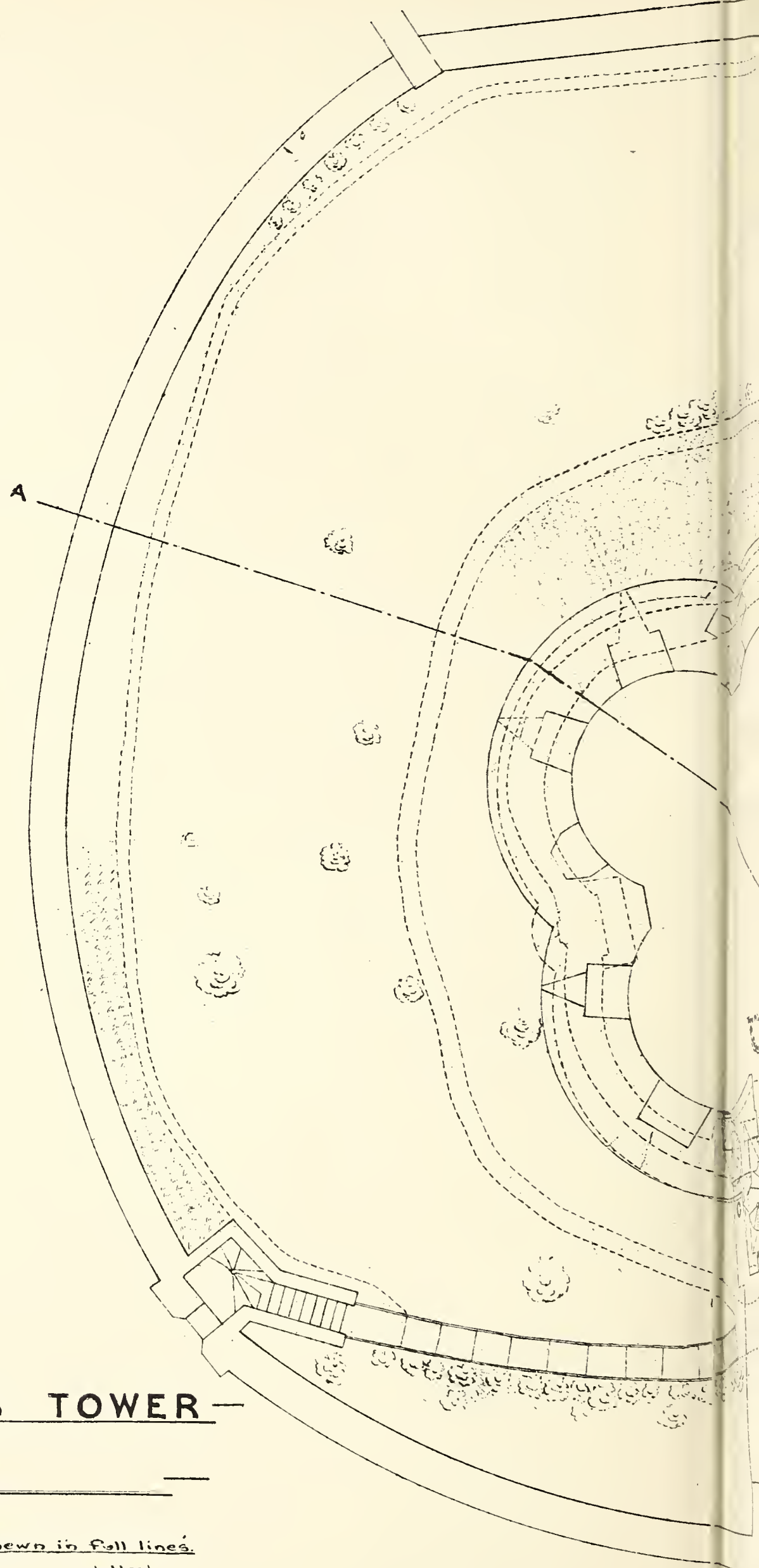


PHOTO-LITHO. SPRAGUE & Co LTD 4 & 5. EAST HARDING STREET, FETTER LANE, E.C.



CLIFFORDS TOWER

YORK.

NOTE. Ground level plan shewn in full lines.
Plan of top of tower " " dotted " .

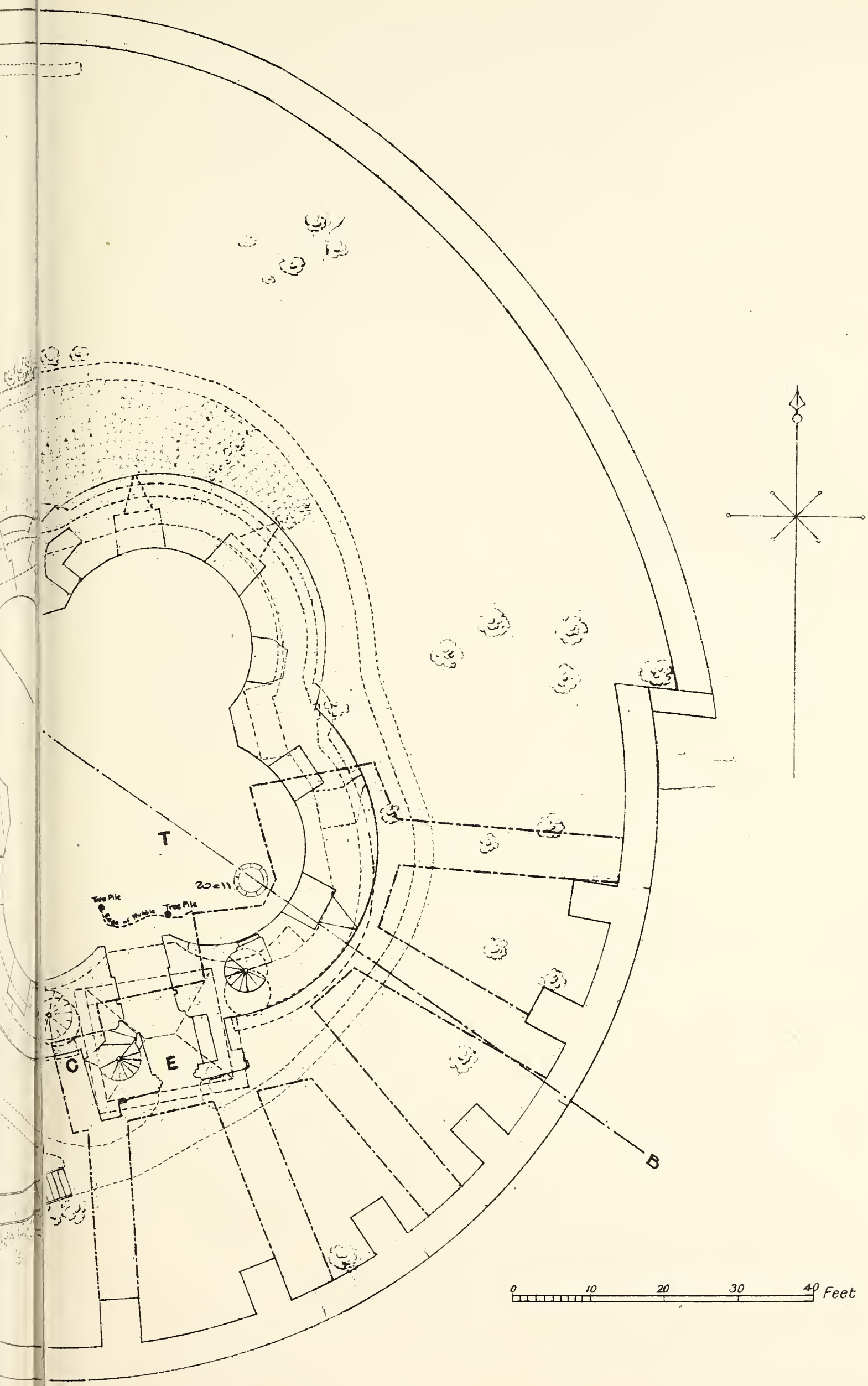
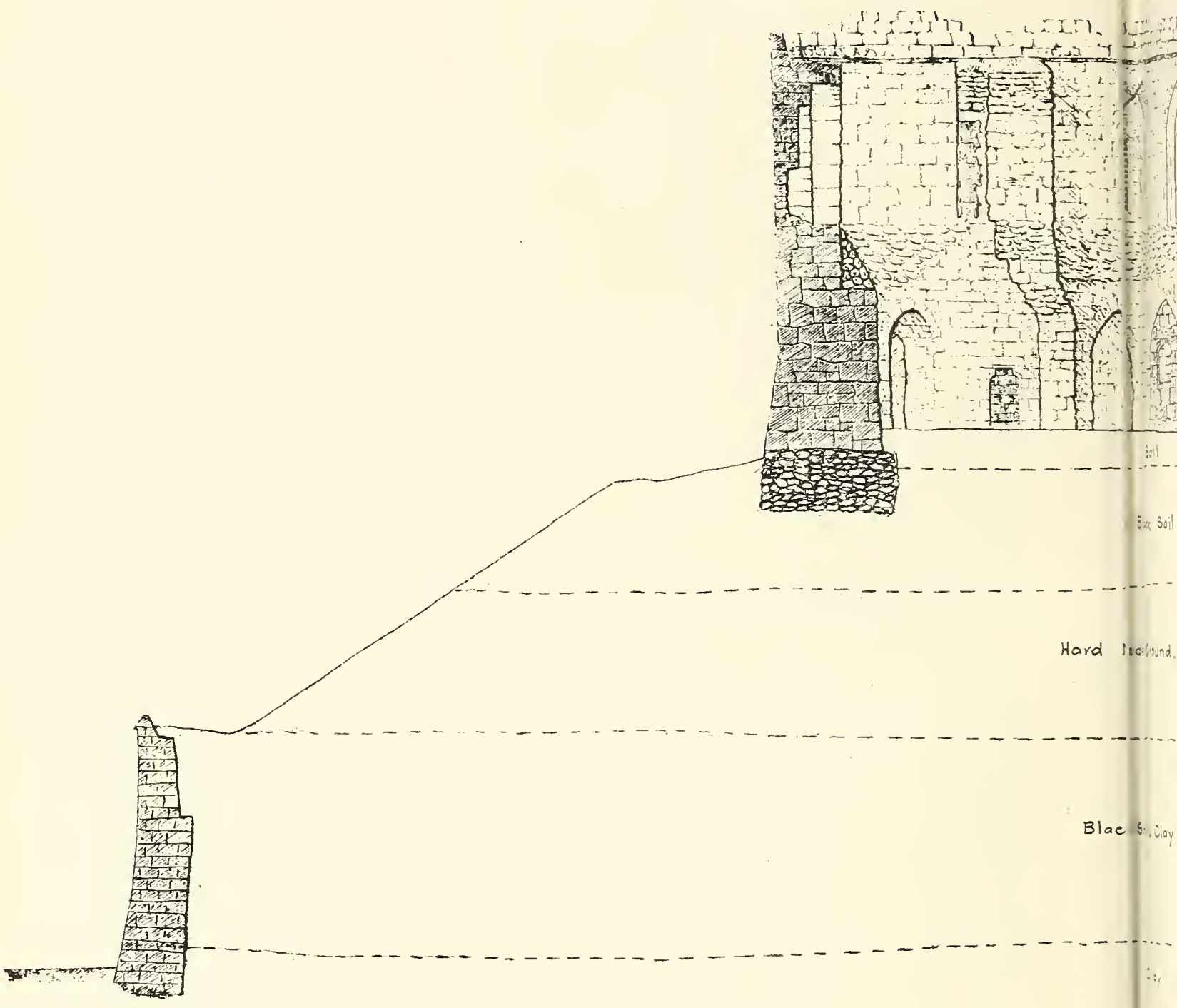


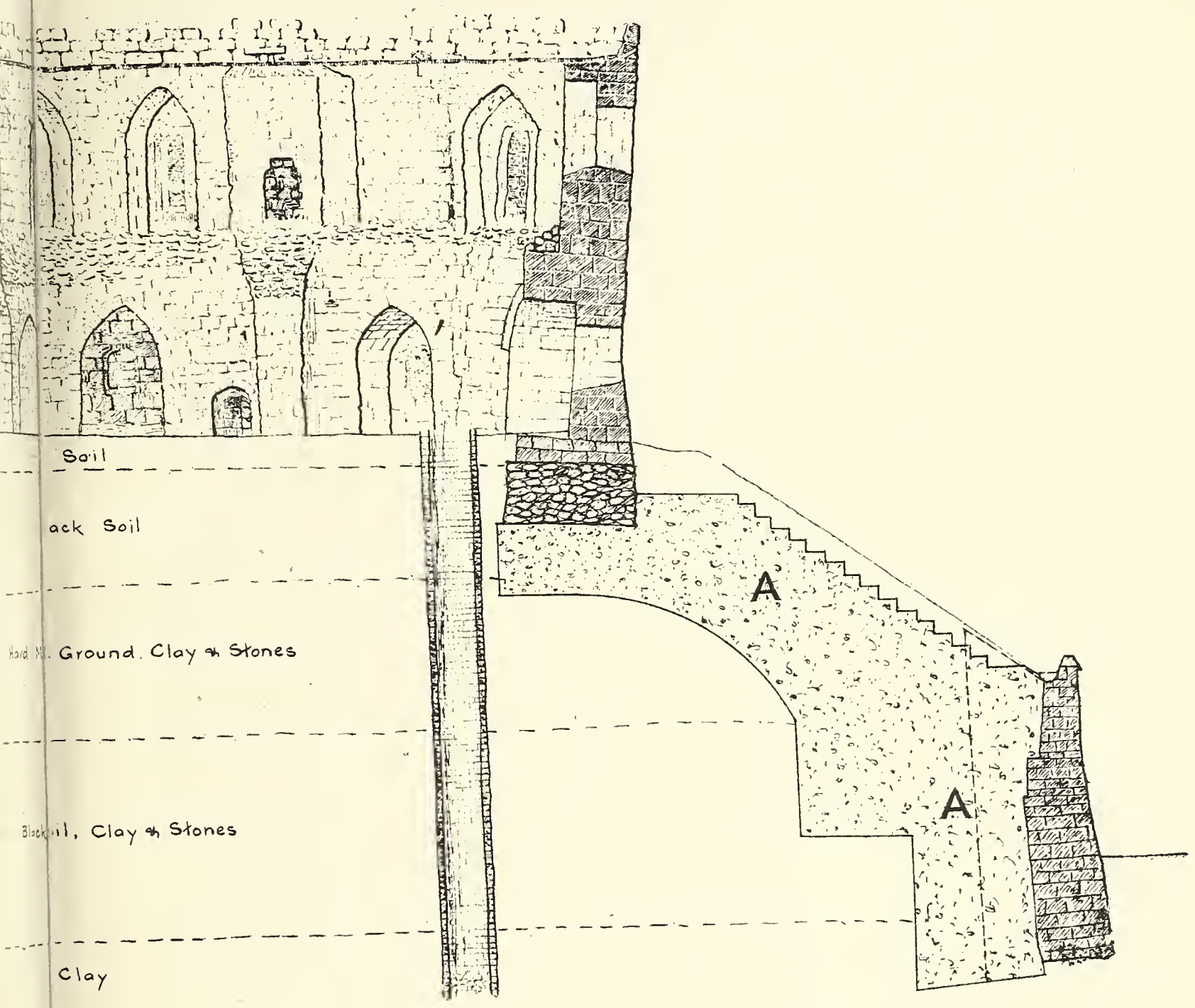
PHOTO-LITHO. SPRAGUE & Co LTD 4 & 5. EAST HARDING STREET, FETTER LANE, E.C.



— CLIFFORDS TOWE

— SECTION ON LINE A.B.

0 10



TOWER YORK

N LINE A.B. SHOWN ON PLAN

30 40 Feet

PHOTO-LITHO. SPRAGUE & Co LTD 4 & 5. EAST HARDING STREET. FETTER LANE. E.C.